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SEALING/ANCHORING TOOL EMPLOYING AN EXPANDABLE METAL CIRCLET

Abstract

Provided is a sealing/anchoring element, a sealing/anchoring tool, a well system, and a method for sealing/anchoring within a wellbore. The sealing/anchoring element, in one aspect, includes a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet having one or more geometric features that allow it to mechanically deform when moved from a radially reduced mechanical state to a radially enlarged mechanical state, the circlet comprising an expandable metal configured to expand in response to hydrolysis to chemically deform the circlet from a radially reduced chemical state to a radially enlarged chemical state.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION [0001] This application is a continuation of U.S. application Ser. No. 18/334,903, filed on Jun. 14, 2023, entitled, “SEALING/ANCHORING TOOL EMPLOYING AN EXPANDABLE METAL CIRCLET,” which claims the benefit of U.S. Provisional Application Ser. No. 63/352,347, filed on Jun. 15, 2022, entitled “EXPANDABLE METAL FOR WASHOUT CONFORMANCE,” commonly assigned with this application and incorporated herein by reference in their entirety.

BACKGROUND
[0002] A typical sealing/anchoring tool (e.g., packer, bridge plug, frac plug, etc.) generally has one or more sealing elements or “rubbers” that are employed to provide a fluid-tight seal radially between a mandrel of the sealing/anchoring tool, and the casing or wellbore into which the scaling/anchoring tool is disposed. A typical sealing/anchoring tool may additionally include one or more anchoring elements (e.g., slip rings) which grip the casing and prevent movement of the sealing/anchoring tool within the casing after the sealing elements have been set. Thus, if weight or fluid pressure is applied to the sealing/anchoring tool, the anchoring elements resist the axial forces on the sealing/anchoring tool produced thereby, and prevent axial displacement of the sealing/anchoring tool relative to the casing and/or wellbore. Such a sealing/anchoring tool is commonly conveyed into a subterranean wellbore suspended from tubing extending to the earth's surface.
[0003] To prevent damage to the elements of the sealing/anchoring tool while the sealing/anchoring tool is being conveyed into the wellbore, the sealing elements and/or anchoring elements may be carried on the mandrel in a relaxed or uncompressed state, in which they are radially inwardly spaced apart from the casing. When the sealing/anchoring tool is set, the sealing elements and/or anchoring elements radially expand (e.g., both radially inward and radially outward in certain instances), thereby sealing and/or anchoring against the mandrel and the casing and/or wellbore. In certain embodiments, the sealing elements and/or anchoring elements are axially compressed between element retainers that straddle them, which in turn radially expand the scaling elements and/or anchoring elements. In other embodiments, the sealing elements and/or anchoring elements are radially expanded by pulling a cone feature therethrough. In yet other embodiments, one or more swellable seal elements are axially positioned between the element retainers, the swellable seal elements configured to radially expand when subjected to one or more different swelling fluids.

Description

BRIEF DESCRIPTION
[0004] Reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:
[0005] FIG. **1**A illustrates a well system designed, manufactured, and operated according to one or more embodiments of the disclosure, the well system including a sealing/anchoring tool including a sealing/anchoring element designed, manufactured and operated according to one or more embodiments of the disclosure;
[0006] FIG. **1**B illustrates one embodiment of a frac plug designed, manufactured and operated

according to one or more embodiments of the disclosure;
[0007] FIG. **1**C illustrates one embodiment of a production packer designed, manufactured and operated according to one or more embodiments of the disclosure;
[0008] FIGS. **2**A through **2**C illustrate one embodiment of a sealing/anchoring element designed, manufactured and operated according to one embodiment of the disclosure;
[0009] FIGS. **3**A and **3**B depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to one embodiment of the disclosure;
[0010] FIGS. **4**A through **4**D depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to an alternative embodiment of the disclosure;
[0011] FIGS. **5**A through **5**D depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to an alternative embodiment of the disclosure;
[0012] FIGS. **6**A through **6**D depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to an alternative embodiment of the disclosure;
[0013] FIGS. **7**A through **7**D depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to an alternative embodiment of the disclosure;
[0014] FIGS. **8**A through **8**D depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to an alternative embodiment of the disclosure;
[0015] FIGS. **9**A through **9**D depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to an alternative embodiment of the disclosure;
[0016] FIGS. **10**A through **10**D depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to an alternative embodiment of the disclosure;
[0017] FIGS. **11**A through **11**D depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to an alternative embodiment of the disclosure;
[0018] FIGS. **12**A through **12**D depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to an alternative embodiment of the disclosure;
[0019] FIGS. **13**A through **13**D depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to an alternative embodiment of the disclosure;
[0020] FIGS. **14**A through **14**D depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to an alternative embodiment of the disclosure; and
[0021] FIGS. **15**A through **15**D depict various different deployment states for a sealing/anchoring tool designed, manufactured and operated according to an alternative embodiment of the disclosure.

DETAILED DESCRIPTION

[0022] In the drawings and descriptions that follow, like parts are typically marked throughout the specification and drawings with the same reference numerals, respectively. The drawn figures are not necessarily to scale. Certain features of the disclosure may be shown exaggerated in scale or in somewhat schematic form and some details of certain elements may not be shown in the interest of clarity and conciseness. The present disclosure may be implemented in embodiments of different forms.
[0023] Specific embodiments are described in detail and are shown in the drawings, with the understanding that the present disclosure is to be considered an exemplification of the principles of the disclosure, and is not intended to limit the disclosure to that illustrated and described herein. It is to be fully recognized that the different teachings of the embodiments discussed herein may be employed separately or in any suitable combination to produce desired results.
[0024] Unless otherwise specified, use of the terms “connect,” “engage,” “couple,” “attach,” or any

other like term describing an interaction between elements is not meant to limit the interaction to direct interaction between the elements and may also include indirect interaction between the elements described. Unless otherwise specified, use of the terms “up,” “upper,” “upward,” “uphole,” “upstream,” or other like terms shall be construed as generally away from the bottom, terminal end of a well; likewise, use of the terms “down,” “lower,” “downward,” “downhole,” or other like terms shall be construed as generally toward the bottom, terminal end of a well, regardless of the wellbore orientation. Use of any one or more of the foregoing terms shall not be construed as denoting positions along a perfectly vertical axis. Unless otherwise specified, use of the term “subterranean formation” shall be construed as encompassing both areas below exposed earth and areas below earth covered by water such as ocean or fresh water.

[0025] The present disclosure describes a scaling/anchoring element employing expandable/expanded metal as a seal and/or anchor in a scaling/anchoring tool. The expandable/expanded metal may embody many different locations, sizes and shapes within the sealing/anchoring element while remaining within the scope of the present disclosure. In at least one embodiment, the expandable/expanded metal reacts with fluids within the wellbore to create a sturdy sealing/anchoring tool. Accordingly, the use of the expandable/expanded metal within the sealing/anchoring element minimizes the likelihood of the sealing/anchoring tool leaks and/or axially slips.

[0026] FIG. **1**A illustrates a well system **100** designed, manufactured, and operated according to one or more embodiments of the disclosure, the well system **100** including a sealing/anchoring tool **150** including a sealing/anchoring element **155** designed, manufactured and operated according to one or more embodiments of the disclosure. The well system **100** includes a wellbore **110** that extends from a terranean surface **120** into one or more subterranean zones **130**. When completed, the well system **100** produces reservoir fluids and/or injects fluids into the subterranean zones **130**. As those skilled in the art appreciate, the wellbore **110** may be fully cased, partially cased, or an open hole wellbore. In the illustrated embodiment of FIG. **1**, the wellbore **110** is at least partially cased, and thus is lined with casing or liner **140**. The casing or liner **140**, as is depicted, may be held into place by cement **145**.

[0027] An example well sealing/anchoring tool **150** is coupled with a tubing string **160** that extends from a wellhead **170** into the wellbore **110**. The tubing string **160** can be coiled tubing and/or a string of joint tubing coupled end to end. For example, the tubing string **160** may be a working string, an injection string, and/or a production string. The sealing/anchoring tool **150** can include a bridge plug, frac plug, packer (e.g., production packer) and/or other scaling/anchoring tool, having a sealing/anchoring element **155** for sealing/anchoring against the wellbore **110** wall (e.g., the casing **140**, a liner and/or the bare rock in an open hole context). The sealing/anchoring element **155** can isolate an interval of the wellbore **110** above the scaling/anchoring element **155** from an interval of the wellbore **110** below the sealing/anchoring element **155**, for example, so that a pressure differential can exist between the intervals.

[0028] In accordance with the disclosure, the sealing/anchoring element **155** may include a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet having one or more geometric features that allow it to mechanically deform when moved from a radially reduced state to a radially enlarged state. In certain embodiments, the circlet may also elasto/plastically deform. The term elasto/plastically, as used herein, refers to mechanical deformation and means that the circlet may elastically deform, may plastically deform, or may both elastically and plastically deform.

[0029] In accordance with one embodiment of the disclosure, the circlet comprises an expandable metal configured to expand in response to hydrolysis. The term expandable metal, as used herein, refers to the expandable metal in a pre-expansion form. Similarly, the term expanded metal, as used herein, refers to the resulting expanded metal after the expandable metal has been subjected to reactive fluid, as discussed below. The expanded metal, in accordance with one or more aspects of the disclosure, comprises a metal that has expanded in response to hydrolysis. In certain embodiments, the expanded metal includes residual unreacted metal. For example, in certain embodiments the expanded metal is intentionally designed to include the residual unreacted metal. The residual unreacted metal has the benefit of allowing the expanded metal to self-heal if cracks or other anomalies subsequently arise, or for example to accommodate changes in the tubular or mandrel diameter due to variations in temperature and/or pressure. Nevertheless, other embodiments may exist wherein no residual unreacted metal exists in the expanded metal.

[0030] The expandable metal, in some embodiments, may be described as expanding to a cement like material. In other words, the expandable metal goes from metal to micron-scale particles and then these particles expand and lock together to, in essence, seal two or more surfaces together. The reaction may, in certain embodiments, occur in less than 2 days in a reactive fluid and in certain temperatures. Nevertheless, the time of reaction may vary depending on the reactive fluid, the expandable metal used, the downhole temperature, and surface-area-to-volume ratio (SA:V) of the expandable metal.

[0031] In some embodiments, the reactive fluid may be a brine solution such as may be produced during well completion activities, and in other embodiments, the reactive fluid may be one of the additional solutions discussed herein. The expandable metal is electrically conductive in certain embodiments. The expandable metal, in certain embodiments, has a yield strength greater than about 8,000 psi, e.g., 8,000 psi+/−50%.

[0032] The hydrolysis of the expandable metal can create a metal hydroxide. The formative properties of alkaline earth metals (Mg—Magnesium, Ca—Calcium, etc.) and transition metals (Zn—Zinc, Al—Aluminum, etc.) under hydrolysis reactions demonstrate structural characteristics that are favorable for use with the present disclosure. Hydration results in an increase in size from the hydration reaction and results in a metal hydroxide that can precipitate from the fluid.

[0033] It should be noted that the starting expandable metal, unless otherwise indicated, is not a metal oxide (e.g., an insulator). In contrast, the starting expandable metal has the properties of traditional metals: 1) Highly conductive to both electricity and heat (e.g., greater than 1,000,000 siemens per meter); 2) Contains a metallic bond (e.g., the outermost electron shell of each of the metal atoms overlaps with a large number of neighboring atoms). As a consequence, the valence electrons are allowed to move from one atom to another and are not associated with any specific pair of atoms. This gives metals their conductive nature; 3) Are malleable and ductile, for example deforming under stress without cleaving; and 4) Tend to be shiny and lustrous with high density. In other embodiments, however, the starting expandable metal is a metal oxide. The hydration reaction for magnesium is:

Mg+2H.sub.2O.fwdarw.Mg(OH).sub.2+H.sub.2,

where Mg(OH).sub.2 is also known as brucite. Another hydration reaction uses aluminum hydrolysis. The reaction forms a material known as Gibbsite, bayerite, boehmite, aluminum oxide, and norstrandite, depending on form. The possible hydration reactions for aluminum are:

Al+3H.sub.2O.fwdarw.Al(OH).sub.3+ 3/2H.sub.2.

Al+2H.sub.2O->AlO(OH)+ 3/2H.sub.2

Al+ 3/2H.sub.2O->½Al.sub.2O.sub.3+ 3/2H.sub.2

Another hydration reaction uses calcium hydrolysis. The hydration reaction for calcium is:

Ca+2H.sub.2O.fwdarw.Ca(OH).sub.2+H.sub.2,

Where Ca(OH).sub.2 is known as portlandite and is a common hydrolysis product of Portland cement. Magnesium hydroxide and calcium hydroxide are considered to be relatively insoluble in

water. Aluminum hydroxide can be considered an amphoteric hydroxide, which has solubility in strong acids or in strong bases. Alkaline earth metals (e.g., Mg, Ca, etc.) work well for the expandable metal, but transition metals (Al, etc.) also work well for the expandable metal. In one embodiment, the metal hydroxide is dehydrated by the swell pressure to form a metal oxide.
[0034] In at least one embodiment, the expandable metal is a non-graphene based expandable metal. By non-graphene based material, it is meant that is does not contain graphene, graphite, graphene oxide, graphite oxide, graphite intercalation, or in certain embodiments, compounds and their derivatized forms to include a function group, e.g., including carboxy, epoxy, ether, ketone, amine, hydroxy, alkoxy, alkyl, aryl, aralkyl, alkaryl, lactone, functionalized polymeric or oligomeric groups, or a combination comprising at least one of the forgoing functional groups. In at least one other embodiment, the expandable metal does not include a matrix material or an exfoliatable graphene-based material. By not being exfoliatable, it is meant that the expandable metal is not able to undergo an exfoliation process. Exfoliation as used herein refers to the creation of individual sheets, planes, layers, laminae, etc. (generally, “layers”) of a graphene-based material; the delamination of the layers; or the enlargement of a planar gap between adjacent ones of the layers, which in at least one embodiment the expandable metal is not capable of.
[0035] In yet another embodiment, the expandable metal does not include graphite intercalation compounds, wherein the graphite intercalation compounds include intercalating agents such as, for example, an acid, metal, binary alloy of an alkali metal with mercury or thallium, binary compound of an alkali metal with a Group V element (e.g., P, As, Sb, and Bi), metal chalcogenide (including metal oxides such as, for example, chromium trioxide, PbO.sub.2, MnO.sub.2, metal sulfides, and metal selenides), metal peroxide, metal hyperoxide, metal hydride, metal hydroxide, metals coordinated by nitrogenous compounds, aromatic hydrocarbons (benzene, toluene), aliphatic hydrocarbons (methane, ethane, ethylene, acetylene, n-hexane) and their oxygen derivatives, halogen, fluoride, metal halide, nitrogenous compound, inorganic compound (e.g., trithiazyl trichloride, thionyl chloride), organometallic compound, oxidizing compound (e.g., peroxide, permanganate ion, chlorite ion, chlorate ion, perchlorate ion, hypochlorite ion, As.sub.2O.sub.5, N.sub.2O.sub.5, CH.sub.3ClO.sub.4, (NH.sub.4).sub.2S.sub.2O.sub.8, chromate ion, dichromate ion), solvent, or a combination comprising at least one of the foregoing. Thus, in at least one embodiment, the expandable metal is a structural solid expanded metal, which means that it is a metal that does not exfoliate and it does not intercalate. In yet another embodiment, the expandable metal does not swell by sorption.
[0036] In an embodiment, the expandable metal used can be a metal alloy. The expandable metal alloy can be an alloy of the base expandable metal with other elements in order to either adjust the strength of the expandable metal alloy, to adjust the reaction time of the expandable metal alloy, or to adjust the strength of the resulting metal hydroxide byproduct, among other adjustments. The expandable metal alloy can be alloyed with elements that enhance the strength of the metal such as, but not limited to, Al—Aluminum, Zn—Zinc, Mn—Manganese, Zr—Zirconium, Y—Yttrium, Nd—Neodymium, Gd—Gadolinium, Ag—Silver, Ca—Calcium, Sn—Tin, and Re—Rhenium, Cu—Copper. In some embodiments, the expandable metal alloy can be alloyed with a dopant that promotes corrosion, such as Ni—Nickel, Fe—Iron, Cu—Copper, Co—Cobalt, Ir—Iridium, Au—Gold, C—Carbon, Ga—Gallium, In—Indium, Mg—Mercury, Bi—Bismuth, Sn—Tin, and Pd—Palladium. The expandable metal alloy can be constructed in a solid solution process where the elements are combined with molten metal or metal alloy. Alternatively, the expandable metal alloy could be constructed with a powder metallurgy process. The expandable metal can be cast, forged, extruded, sintered, welded, mill machined, lathe machined, stamped, eroded or a combination thereof. The metal alloy can be a mixture of the metal and metal oxide. For example, a powder mixture of aluminum and aluminum oxide can be ball-milled together to increase the reaction rate.
[0037] Optionally, non-expanding components may be added to the starting metallic materials. For example, ceramic, elastomer, plastic, epoxy, glass, or non-reacting metal components can be

embedded in the expandable metal or coated on the surface of the expandable metal. In yet other embodiments, the non-expanding components are metal fibers, a composite weave, a polymer ribbon, or ceramic granules, among others. In one variation, the expandable metal is formed in a serpentinite reaction, a hydration and metamorphic reaction. In one variation, the resultant material resembles a mafic material. Additional ions can be added to the reaction, including silicate, sulfate, aluminate, carbonate, and phosphate. The metal can be alloyed to increase the reactivity or to control the formation of oxides.

[0038] The expandable metal can be configured in many different fashions, as long as an adequate volume of material is available for anchoring and/or sealing. For example, the expandable metal may be formed into a single long member, multiple short members, rings, among others. In another embodiment, the expandable metal may be formed into a long wire of expandable metal, that can be in turn be wound around a mandrel as a sleeve. The wire diameters do not need to be of circular cross-section, but may be of any cross-section. For example, the cross-section of the wire could be oval, rectangle, star, hexagon, keystone, hollow braided, woven, twisted, among others, and remain within the scope of the disclosure. In certain other embodiments, the expandable metal is a collection of individual separate chunks of the metal held together with a binding agent. In yet other embodiments, the expandable metal is a collection of individual separate chunks of the metal that are not held together with a binding agent, but held in place using one or more different techniques, including an enclosure (e.g., an enclosure that could be crushed to expose the individual separate chunks to the reactive fluid), a cage, etc.

[0039] Additionally, a delay coating or protective layer may be applied to one or more portions of the expandable metal to delay the expanding reactions. In one embodiment, the material configured to delay the hydrolysis process is a fusible alloy. In another embodiment, the material configured to delay the hydrolysis process is a eutectic material. In yet another embodiment, the material configured to delay the hydrolysis process is a wax, oil, or other non-reactive material. The delay coating or protective layer may be applied to any of the different expandable metal configurations disclosed above.

[0040] Turning briefly to FIG. **1**B, illustrated is one embodiment of a frac plug **180** designed, manufactured and operated according to one or more embodiments of the disclosure. The frac plug **180**, in the illustrated embodiment, could function as the sealing/anchoring element **150** of FIG. **1**A. Accordingly, the frac plug **180** could include the aforementioned circlet, for example a circlet comprising an expandable metal configured to expand in response to hydrolysis.

[0041] Turning briefly to FIG. IC, illustrated is one embodiment of a production packer **190** designed, manufactured and operated according to one or more embodiments of the disclosure. The production packer **190**, in the illustrated embodiment, could function as the sealing/anchoring element **150** of FIG. **1**A. Accordingly, the production packer **190** could include the aforementioned circlet, for example a circlet comprising an expandable metal configured to expand in response to hydrolysis.

[0042] Turning to FIGS. **2**A through **2**C, illustrated are various different views of one embodiment of a sealing/anchoring element **200** designed, manufactured and operated according to one embodiment of the disclosure. The sealing/anchoring element **200**, in the illustrated embodiment, includes a circlet **210** having an inside surface with an inside diameter (d.sub.i), an outside surface with an outside diameter (d.sub.o), a width (w), and a wall thickness (t). The circlet **210**, in the illustrated embodiment, additionally includes one or more geometric features **220** that allow it to mechanically deform when moved from a radially reduced state to a radially enlarged state. Further to the embodiment of FIGS. **2**A through **2**C, the circlet **210** comprises an expandable metal configured to expand in response to hydrolysis, such as discussed in the paragraphs above, and thereby chemically deform from a radially reduced chemical state to a radially expanded chemical state.

[0043] In the illustrated embodiment, the one or more geometric features **220** are a slot or partial slot in the wall thickness (t) of the circlet **210**. For example, a full slot could be used, thereby turning the circlet **210** into a C-ring of sorts. Alternatively, a partial slot could be used, such as shown in FIGS. **2**A through **2**C, such that the circlet is a full ring when in the radially reduced state, but snaps any remaining material **230** of the partial slot when the circlet **210** is moved to the radially enlarged state. In at least one embodiment, wherein multiple circlets are used, the one or more geometric features (e.g., slots) may be radially staggered around the mandrel.

[0044] In at least the embodiment of FIGS. **2**A through **2**C, the circlet **210** includes one or more angled surfaces **240** positioned along its inside diameter (d.sub.i) and/or outside diameter (d.sub.o). In at least the embodiment of FIGS. **2**A through **2**C, the angled surfaces **240** are configured to engage one or more associated wedges of a sealing/anchoring tool or one or more angled surfaces of another proximate circlet, for example to move the circlet **210** between the radially reduced state (e.g., as shown) and the radially enlarged state.

[0045] In at least one embodiment, the width (w) is no greater than 2.75 meters (e.g., about 9 feet). In at least one other embodiment, the width (w) is no greater than 1.83 meters (e.g., about 6 feet), if not no greater than 2.54 cm (e.g., 1 inch) or even 1 cm (e.g., 0.39 inches). In yet at least another embodiment, the width (w) ranges from 0.3 meters (e.g., about 1 foot) to 1.2 meters (e.g., about 4 feet). In at least one embodiment, the thickness (t) is no greater than 15 centimeters (e.g., about 5.9 inches). In at least one other embodiment, the thickness (t) is no greater than 9 centimeters (e.g., about 3.5 inches), if not no greater than 2.54 cm (e.g., 1 inch) or even 1 cm (e.g., 0.39 inches), or even 0.5 cm (e.g., 0.20 inches). In yet at least another embodiment, the thickness (t) ranges from 15 centimeters (e.g., about 5.9 inches) to 6 centimeters (e.g., about 2.4 inches).

[0046] Turning to FIGS. **3**A and **3**B, illustrated are a perspective view and a cross-sectional view of one embodiment of a sealing/anchoring tool **300** designed, manufactured and operated according to an alternative embodiment of the disclosure. The sealing/anchoring tool **300**, in the illustrated embodiment, includes a mandrel **310**. Any mandrel **310** according to the disclosure may be used. The sealing/anchoring tool **300** additionally includes one or more wedges **320** (e.g., which may also comprise a metal configured to expand in response to hydrolysis) positioned about the mandrel **310**, as well as one or more sealing/anchoring elements **330** positioned about the mandrel **310** and proximate the one or more wedges **320**. The one or more sealing/anchoring elements **330**, may be similar to the sealing/anchoring element **200** disclosed above, or similar to any other design of a sealing/anchoring element according to one or more embodiments of the disclosure.

[0047] In the illustrated embodiment, the sealing/anchoring tool **300** includes a plurality of scaling/anchoring elements **330**, each comprising one or more circlets **340**, positioned between two or more wedges **320**. Accordingly, the wedges **320** may be moved relative to one another (e.g., one of the wedges **320** may be fixed with the other of the wedges **320** moves, both of the wedges **320** may move, etc.) to move the circlets **340** from the radially reduced mechanical state as shown in FIG. **3**B, to the radially enlarged mechanical state (not shown). Furthermore, as the circlets **340** comprise a metal configured to expand in response to hydrolysis, they may also chemically deform to move from a radially reduced chemical state to a radially enlarged chemical state. In certain embodiments, the mechanical expansion occurs prior to any chemical expansion, thus the circlets **340** would initially move from the radially reduced mechanical state to the radially enlarged mechanical state, and then at some point thereafter, the circlets **340** would move from the radially reduced chemical state (e.g., also the radially enlarged mechanical state) to the radially enlarged chemical state. In yet other embodiments, the mechanical expansion and the chemical expansion work at least partially in unison. However, it is unlikely (but not impossible) that the chemical expansion would start and complete prior to the mechanical expansion.

[0048] Turning now to FIGS. **4**A through **4**D, illustrated are various different deployment states for a sealing/anchoring tool **400** designed, manufactured and operated according to one aspect of the disclosure. FIG. **4**A illustrates the sealing/anchoring tool **400** in a run-in-hole state, and thus its sealing/anchoring element is in the radially reduced mechanical state, and furthermore the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **4**B illustrates the sealing/anchoring tool **400** with its sealing/anchoring element in the radially enlarged mechanical state, but again the expandable metal has not been subjected to reactive fluid to begin hydrolysis (e.g., and thus is in its radially reduced chemical state). In contrast, FIG. **4**C illustrates the sealing/anchoring tool **400** with its radially enlarged scaling/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element (e.g., the sealing/anchoring element post-expansion, or in a radially enlarged chemical state). As disclosed above, the expandable metal may be subjected to a suitable reactive fluid within the wellbore, thereby forming the expanded metal sealing/anchoring element. In contrast, FIG. **4**D illustrates the scaling/anchoring tool **400** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal scaling/anchoring element (e.g., the sealing/anchoring element post-expansion, or in a radially enlarged chemical state), but also having residual unreacted expandable metal therein.

[0049] The sealing/anchoring tool **400**, in the illustrated embodiment of FIGS. **4**A through **4**D, includes a mandrel **410**. The mandrel **410**, in the illustrated embodiment, is centered about a centerline (C.sub.L). The sealing/anchoring tool **400**, in at least the embodiment of FIGS. **4**A through **4**D, is located in a bore **490** positioned around the mandrel **410**. The bore **490**, in at least one embodiment, is a tubular positioned within a wellbore, such as a casing, production tubing, etc. The bore **490**, in at least one other embodiment, is exposed wellbore. In accordance with one aspect of the disclosure, the mandrel **410** and the bore **490** form an annulus **480**. In one or more embodiments of the disclosure, the sealing/anchoring tool **400** is a frac plug or production packer, among other tools, and thus may provide sealing or anchoring, or both sealing and anchoring.

[0050] In accordance with one embodiment of the disclosure, the sealing/anchoring tool **400** includes one or more sealing/anchoring elements **420** positioned about the mandrel **410**. In at least one embodiment, the sealing/anchoring elements **420** include one or more circlets **430**. The circlets **430**, as discussed above, may include an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t). Furthermore, at least a portion of the circlets **430** may comprise a metal configured to expand in response to hydrolysis.

[0051] The circlets **430** may additionally include one or more geometric features that allow them to mechanically deform when moved from a radially reduced mechanical state to a radially enlarged mechanical state. In at least one embodiment, the one or more geometric features are one or more cuts (not shown) (e.g., axial cuts extending entirely through the wall thickness (t) along the width (w)). Nevertheless, other geometric features are within the scope of the disclosure.

[0052] In the illustrated embodiment, each of the circlets **430** includes a delay coating or protective layer **440**. The delay coating or protective layer **440** may be similar to any of those disclosed herein. Further to the embodiment of FIG. **4**A, each of the circlets **430** may have a roughened surface **450**. The roughened surface **450** may be employed to remove portions of the delay coating or protective layer **440** as the circlets **430** slide relative to one another, and thus help expose the circlets **430** to the reactive fluid. In at least one embodiment, the roughened surface is a series of spikes, ridges, and/or threads. Nevertheless, any type of roughened surface is within the scope of the disclosure. For example, the roughened surface **450** may have an average surface roughness (R.sub.a) of at least about 0.8 μm. In yet another embodiment, the roughened surface **450** may have an average surface roughness (R.sub.a) of at least about 6.3 μm, or in yet an even different embodiment may have an average surface roughness (R.sub.a) of at least about 12.5 μm, if not at least 1 mm.

[0053] The sealing/anchoring tool **400**, in the illustrated embodiment, additionally includes the one or more associated wedges **460** (e.g., a first wedge and a second wedge located on opposing sides of the sealing/anchoring element **420**). The one or more associated wedges **460**, in one or more embodiments, are configured to axially slide along the mandrel **410** relative to the circlets **430** to move the circlets **430** from the radially reduced mechanical state to the radially enlarged mechanical state (e.g., the first and second wedges configured to axial slide along the mandrel relative to one another to move the circlet from the radially reduced mechanical state to the radially enlarged mechanical state, as if it were a frac plug). The one or more associated wedges **460**, in the illustrated embodiment, include one or more associated angled surfaces. As is evident in the embodiment of FIGS. **4**A through **4**D, the one or more associated angled surfaces are operable to engage with the opposing angled surfaces of the circlets **430**, and thus move the circlets **430** between the radially reduced mechanical state (e.g., as shown in FIG. **4**A) and a radially enlarged mechanical state (e.g., as shown in FIGS. **4**B).

[0054] The sealing/anchoring tool **400**, in the illustrated embodiment, may additionally include one or more end rings **470** located on opposing sides of the one or more associated wedges **460**. In the illustrated embodiment, one of the end rings **470** may be axially fixed relative to the mandrel **410** or the bore **490**, and the other of the end rings **470** is allowed to axially move relative to the mandrel **410** or the bore **490**, and thus move the circlet **430** between the radially reduced mechanical state (e.g., as shown in FIG. **4**A) and a radially enlarged mechanical state (e.g., as shown in FIG. **4**B). In yet another embodiments, both of the end rings **470** are allowed to axially move.

[0055] The sealing/anchoring tool **400**, in one or more embodiments, may additionally include a piston structure (not shown) for axially moving one or more of the free end rings **470**. Accordingly, the piston structure may be used to move the circlet **430** between the radially reduced mechanical state (e.g., as shown in FIG. **4**A) and a radially enlarged mechanical state (e.g., as shown in FIGS. **4**B). The piston structure may take on many different designs while remaining within the scope of the present disclosure.

[0056] With reference to FIG. **4**A, the circlet(s) **430** may comprise any of the expandable metals discussed above. The circlet(s) **430** may have a variety of different shapes, sizes, etc. and remain within the scope of the disclosure.

[0057] With reference to FIG. **4**B, illustrated is the sealing/anchoring tool **400** of FIG. **4**A after mechanically setting the sealing/anchoring element **420**. In the illustrated embodiment of FIG. **4**B, the sealing/anchoring element **420** is set by axially moving (e.g., by way of the piston) the end rings **470** relative to one another and thereby engaging the one or more associated angled surfaces of the one or more wedges **460** with the opposing angled surfaces of the circlet **430**. Accordingly, the sealing/anchoring element **420** is moved between the radially reduced mechanical state (e.g., as shown in FIG. **4**A) and the radially enlarged mechanical state shown in FIG. **4**B. In at least one embodiment, the mechanical deformation increases the outside diameter by at least 5 percent. In yet another embodiment, the mechanical deformation increases the outside diameter by at least 20 percent, and in yet one other embodiment the mechanical deformation increases the outside diameter by a range of 5 percent to 50 percent.

[0058] In the illustrated embodiment of FIG. **4**B, the sealing/anchoring element **420** engages with the bore **490**, thereby spanning the annulus **480**. Further to the embodiment of FIG. **4**B, the circlet **430** has been mechanically deformed. Thus, in certain instances the circlet **430** has been elastically deformed, in certain other instances the circlet **430** has been plastically deformed, and in yet other embodiments the circlet **430** has been elastically and plastically deformed.

[0059] With reference to FIG. **4**C, illustrated is the scaling/anchoring tool **400** of FIG. **4**B after subjecting the sealing/anchoring element **420** to reactive fluid to form an expanded metal sealing/anchoring element **475***a*, as discussed above. The reactive fluid may be any of the reactive fluid discussed above. In the illustrated embodiment of FIG. **4**C, the expanded metal sealing/anchoring element **475***a* at least partially fills the annulus **480**, and thereby acts as a seal/anchor. For example, the expanded metal sealing/anchoring element **475***a* might act as a seal, with very little anchoring ability. In yet other embodiments, the expanded metal sealing/anchoring element **475***a* might act as an anchor, with very little sealing ability. In even yet other embodiments, the expanded metal sealing/anchoring element **475***a* might act as a highly suitable seal and anchor. It should be noted, that as the expanded metal sealing/anchoring element **475***a* remains in the radially enlarged state regardless of the force from the piston structure, certain embodiments may remove the force from the piston structure after the expanded metal sealing/anchoring element **475***a* has been formed. Furthermore, the structure would not require any body lock rings, as might be required in the prior art structures.

[0060] In certain embodiments, the time period for the hydration of the circlet **430** is different from the time period for setting the sealing/anchoring element **420**. For example, the setting of the sealing/anchoring element **420** might create a quick, but weaker, seal/anchor for the sealing/anchoring tool **400**, whereas the circlet **430** could take multiple hours to several days for the hydrolysis process to fully expand, but provide a strong seal/anchor for the sealing/anchoring tool **400**.

[0061] While not shown, the sealing/anchoring tool **400**, and more particularly the sealing/anchoring element **420** of the sealing/anchoring tool **400**, may additionally include one or more additional sealing elements. For example, the one or more additional sealing elements could be located uphole or downhole of the sealing/anchoring element **420**, and thus be used to fluidly seal the annulus **480**. In many situations, the one or more additional sealing elements comprise elastomeric sealing elements that are located downhole of the scaling/anchoring element **420**.

[0062] A sealing/anchoring tool, and related sealing/anchoring element, according to the present disclosure may provide higher technical ratings and/or may provide a lower cost alternative to existing sealing/anchoring elements contained of today's packers and frac plugs. A scaling/anchoring tool, and related sealing/anchoring element, employs a game changing material that gets away from the issues found in conventional elastomeric devices, such as: extreme temperature limits, low temperature sealing limits, swabbing while running, extrusion over time, conforming to irregular shapes, etc.

[0063] With reference to FIG. **4**D, illustrated is the sealing/anchoring tool **400** of FIG. **4**C after subjecting the sealing/anchoring element **420** to reactive fluid to form an expanded metal, the sealing/anchoring element having residual unreacted expandable metal therein **475***b*, as discussed above.

[0064] Turning to FIGS. **5**A through **5**D, depicted are various different deployment states for a scaling/anchoring tool **500** designed, manufactured and operated according to an alternative embodiment of the disclosure. FIG. **5**A illustrates the sealing/anchoring tool **500** in a run-in-hole state, and thus its sealing/anchoring element is in the radially reduced mechanical state, and furthermore the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **5**B illustrates the sealing/anchoring tool **500** with its sealing/anchoring element in the radially enlarged mechanical state, but again the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **5**C illustrates the sealing/anchoring tool **500** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal scaling/anchoring element (e.g., the sealing/anchoring element post-expansion). In contrast, FIG. **5**D illustrates the sealing/anchoring tool **500** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element having residual unreacted expandable metal therein (e.g., the sealing/anchoring element post-expansion). As disclosed above, the expandable metal may be subjected to a suitable reactive fluid within the wellbore, thereby forming the expanded metal sealing/anchoring element.

[0065] The sealing/anchoring tool **500** is similar in certain respects to the sealing/anchoring tool **400**. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The scaling/anchoring tool **500** differs, for the most part, from the sealing/anchoring tool

400, in that the sealing/anchoring tool **500** employs a sealing/anchoring element **520** with different shaped circlets **530**. The different shaped circlets **530** of FIGS. **5**A through **5**D, in at least one embodiment, substantially prevent the circlets **530** from contacting the bore **490** when they move from the radially reduced mechanical state to the radially enlarged mechanical state (e.g., act as a mechanical expansion limiter). For example, in at least one embodiment, a move from the radially reduced mechanical state to the radially expanded mechanical state leaves a gap **580** of at least 5% of the annulus **480**, and thus the remaining 5% must be closed with chemical expansion. In yet another embodiment, a move from the radially reduced mechanical state to the radially expanded mechanical state leaves a gap **580** of at least 10% of the annulus **480**, and thus the remaining 10% must be closed with chemical expansion. In yet another embodiment, a move from the radially reduced mechanical state to the radially expanded mechanical state leaves a gap **580** of at least 20% of the annulus **480**, and thus the remaining 20% must be closed with chemical expansion. In yet another embodiment, a move from the radially reduced mechanical state to the radially expanded mechanical state leaves a gap **580** of at least 30% of the annulus **480**, and thus the remaining 30% must be closed with chemical expansion. In yet another embodiment, a move from the radially reduced mechanical state to the radially expanded mechanical state leaves a gap **580** ranging from 15% to 25% of the annulus **480**, and thus the remaining 15% to 25% must be closed with chemical expansion.

[0066] Through experimentation, it has been determined that the gap **580** has certain previously unknown benefits, including the ability for reactive fluid to readily access the circlets **530**. What may result in one or more embodiments, after hydrolysis, is the expanded metal scaling/anchoring element **575***a*, as shown in FIG. **5**C, or the expanded metal sealing/anchoring element having residual unreacted expandable metal therein **575***b*, as shown in FIG. **5**D.

[0067] Turning to FIGS. **6**A through **6**D, depicted are various different deployment states for a sealing/anchoring tool **600** designed, manufactured and operated according to an alternative embodiment of the disclosure. FIG. **6**A illustrates the sealing/anchoring tool **600** in a run-in-hole state, and thus its sealing/anchoring element is in the radially reduced mechanical state, and furthermore the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **6**B illustrates the sealing/anchoring tool **600** with its sealing/anchoring element in the radially enlarged mechanical state, but again the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **6**C illustrates the sealing/anchoring tool **600** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal scaling/anchoring element (e.g., the sealing/anchoring element post-expansion). In contrast, FIG. **6**D illustrates the scaling/anchoring tool **600** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal scaling/anchoring element having residual unreacted expandable metal therein (e.g., the sealing/anchoring element post-expansion). As disclosed above, the expandable metal may be subjected to a suitable reactive fluid within the wellbore, thereby forming the expanded metal sealing/anchoring element.

[0068] The sealing/anchoring tool **600** is similar in certain respects to the sealing/anchoring tool **500**. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The sealing/anchoring tool **600** differs, for the most part, from the sealing/anchoring tool **500**, in that the scaling/anchoring tool **600** is capable of sealing a bore **690** with large changes in diameter in all directions (e.g., an irregular bore **490** size that may occur as a result of washout). What may result in one or more embodiments, after hydrolysis, is the expanded metal sealing/anchoring element **675***a*, as shown in FIG. **6**C, or the expanded metal sealing/anchoring element having residual unreacted expandable metal therein **675***b*, as shown in FIG. **6**D.

[0069] Turning to FIGS. **7**A through **7**D, depicted are various different deployment states for a sealing/anchoring tool **700** designed, manufactured and operated according to an alternative embodiment of the disclosure. FIG. **7**A illustrates the scaling/anchoring tool **700** in a run-in-hole state, and thus its sealing/anchoring element is in the radially reduced mechanical state, and furthermore the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **7**B illustrates the scaling/anchoring tool **700** with its sealing/anchoring element in the radially enlarged mechanical state, but again the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **7**C illustrates the sealing/anchoring tool **700** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element (e.g., the sealing/anchoring element post-expansion). In contrast, FIG. **7**D illustrates the sealing/anchoring tool **700** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element having residual unreacted expandable metal therein (e.g., the sealing/anchoring element post-expansion). As disclosed above, the expandable metal may be subjected to a suitable reactive fluid within the wellbore, thereby forming the expanded metal sealing/anchoring element.

[0070] The sealing/anchoring tool **700** is similar in certain respects to the sealing/anchoring tool **500**. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The sealing/anchoring tool **700** differs, for the most part, from the scaling/anchoring tool **500**, in that the scaling/anchoring tool **700** employs a sealing/anchoring element **720** with different shaped circlets **730**, and furthermore includes alternating members that expand in response to hydrolysis and do not expand in response to hydrolysis. What may result in one or more embodiments, after hydrolysis, is the expanded metal sealing/anchoring element **775***a*, as shown in FIG. **7**C, or the expanded metal sealing/anchoring element having residual unreacted expandable metal therein **775***b*, as shown in FIG. **7**D.

[0071] Turning to FIGS. **8**A through **8**D, depicted are various different deployment states for a scaling/anchoring tool **800** designed, manufactured and operated according to an alternative embodiment of the disclosure. FIG. **8**A illustrates the sealing/anchoring tool **800** in a run-in-hole state, and thus its scaling/anchoring element is in the radially reduced mechanical state, and furthermore the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **8**B illustrates the scaling/anchoring tool **800** with its scaling/anchoring element in the radially enlarged mechanical state, but again the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **8**C illustrates the sealing/anchoring tool **800** with its radially enlarged scaling/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal scaling/anchoring element (e.g., the scaling/anchoring element post-expansion). In contrast, FIG. **8**D illustrates the scaling/anchoring tool **800** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element having residual unreacted expandable metal therein (e.g., the sealing/anchoring element post-expansion). As disclosed above, the expandable metal may be subjected to a suitable reactive fluid within the wellbore, thereby forming the expanded metal scaling/anchoring element.

[0072] The sealing/anchoring tool **800** is similar in certain respects to the sealing/anchoring tool **400**. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The scaling/anchoring tool **800** differs, for the most part, from the scaling/anchoring tool **400**, in that the scaling/anchoring tool **800** employs a wedge **860** comprising the metal configured to expand in response to hydrolysis, as well as employs a piston **810**. What may result in one or more embodiments, after hydrolysis, is the expanded metal scaling/anchoring element **875***a*, as shown in FIG. **8**C, or the expanded metal sealing/anchoring element having residual unreacted expandable metal therein **875***b*, as shown in FIG. **8**D.

[0073] Turning to FIGS. **9**A through **9**D, depicted are various different deployment states for a scaling/anchoring tool **900** designed, manufactured and operated according to an alternative embodiment of the disclosure. FIG. **9**A illustrates the sealing/anchoring tool **900** in a run-in-hole state, and thus its scaling/anchoring element is in the radially reduced mechanical state, and furthermore the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **9**B illustrates the scaling/anchoring tool **900** with its sealing/anchoring element in the radially enlarged mechanical state, but again the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **9**C illustrates the scaling/anchoring tool **900** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element (e.g., the sealing/anchoring element post-expansion). In contrast, FIG. **9**D illustrates the sealing/anchoring tool **900** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal scaling/anchoring element having residual unreacted expandable metal therein (e.g., the sealing/anchoring element post-expansion). As disclosed above, the expandable metal may be subjected to a suitable reactive fluid within the wellbore, thereby forming the expanded metal scaling/anchoring element.

[0074] The sealing/anchoring tool **900** is similar in certain respects to the sealing/anchoring tool **800**. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The sealing/anchoring tool **900** differs, for the most part, from the sealing/anchoring tool **800**, in that the scaling/anchoring tool **900** employs a sealing/anchoring element **920** with different shaped circlets **930** that substantially prevent the circlets **930** from contacting the bore **490** when they move from the radially reduced mechanical state to the radially enlarged mechanical state. What may result in one or more embodiments, after hydrolysis, is the expanded metal sealing/anchoring element **975***a*, as shown in FIG. **9**C, or the expanded metal sealing/anchoring element having residual unreacted expandable metal therein **975***b*, as shown in FIG. **9**D.

[0075] Turning to FIGS. **10**A through **10**D, depicted are various different deployment states for a sealing/anchoring tool **1000** designed, manufactured and operated according to an alternative embodiment of the disclosure. FIG. **10**A illustrates the sealing/anchoring tool **1000** in a run-in-hole state, and thus its sealing/anchoring element is in the radially reduced mechanical state, and furthermore the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **10**B illustrates the sealing/anchoring tool **1000** with its sealing/anchoring element in the radially enlarged mechanical state, but again the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **10**C illustrates the sealing/anchoring tool **1000** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal scaling/anchoring element (e.g., the sealing/anchoring element post-expansion). In contrast, FIG. **10**D illustrates the sealing/anchoring tool **1000** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element having residual unreacted expandable metal therein (e.g., the sealing/anchoring element post-expansion). As disclosed above, the expandable metal may be subjected to a suitable reactive fluid within the wellbore, thereby forming the expanded metal sealing/anchoring element.

[0076] The scaling/anchoring tool **1000** is similar in certain respects to the sealing/anchoring tool **800**. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The sealing/anchoring tool **1000** differs, for the most part, from the sealing/anchoring tool **800**, in that the sealing/anchoring tool **1000** does not employ a wedge **860**, but employs a hydraulically deformable member **1010** to radially deploy its sealing/anchoring element **1020** with its one or more circlets **1030** (e.g., comprising a metal configured to expand in response to hydrolysis). In the illustrated embodiment, the hydraulically deformable member **1010** is a bladder. Nevertheless, other hydraulically deformable member may be used and remain within the scope of the disclosure. Furthermore, in one or more embodiments the mandrel **410** includes one or more plugs and/or openings **1015** for supplying fluid to deploy the hydraulically deformable member **1010** from its radially reduced mechanical state (FIG. **10**A) to its radially expanded mechanical state (FIG. **10**B). What may result in one or more embodiments, after hydrolysis, is the expanded metal sealing/anchoring element **1075***a*, as shown in FIG. **10**C, or the expanded metal sealing/anchoring element having residual unreacted expandable metal therein **1075***b*, as shown in FIG. **10**D.

[0077] Turning to FIGS. **11**A through **11**D, depicted are various different deployment states for a sealing/anchoring tool **1100** designed, manufactured and operated according to an alternative embodiment of the disclosure. FIG. **11**A illustrates the sealing/anchoring tool **1100** in a run-in-hole state, and thus its sealing/anchoring element is in the radially reduced mechanical state, and furthermore the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **11**B illustrates the sealing/anchoring tool **1100** with its sealing/anchoring element in the radially enlarged mechanical state, but again the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **11**C illustrates the sealing/anchoring tool **1100** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal scaling/anchoring element (e.g., the sealing/anchoring element post-expansion). In contrast, FIG. **11**D illustrates the sealing/anchoring tool **1100** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element having residual unreacted expandable metal therein (e.g., the sealing/anchoring element post-expansion). As disclosed above, the expandable metal may be subjected to a suitable reactive fluid within the wellbore, thereby forming the expanded metal sealing/anchoring element.

[0078] The sealing/anchoring tool **1100** is similar in certain respects to the sealing/anchoring tool **1000**. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The sealing/anchoring tool **1100** differs, for the most part, from the scaling/anchoring tool **1000**, in that the sealing/anchoring tool **1100** employs a hydraulically deformable member **1110** with limited expansion. The limited expansion hydraulically deformable member **1110** of FIGS. **11**A through **11**D, in at least one embodiment, substantially prevent the circlet **1030** from contacting the bore **490** when the hydraulically deformable member **1110** moves from the radially reduced mechanical state to the radially enlarged mechanical state. For example, in at least one embodiment, a move from the radially reduced mechanical state to the radially expanded mechanical state leaves a gap **1180** of at least 5% of the annulus **480**, and thus the remaining 5% must be closed with chemical expansion. In yet another embodiment, a move from the radially reduced mechanical state to the radially expanded mechanical state leaves a gap **1180** of at least 10% of the annulus **480**, and thus the remaining 10% must be closed with chemical expansion. In yet another embodiment, a move from the radially reduced mechanical state to the radially expanded mechanical state leaves a gap **1180** of at least 20% of the annulus **480**, and thus the remaining 20% must be closed with chemical expansion. In yet another embodiment, a move from the radially reduced mechanical state to the radially expanded mechanical state leaves a gap **1180** of at least 30% of the annulus **480**, and thus the remaining 30% must be closed with chemical expansion. In yet another embodiment, a move from the radially reduced mechanical state to the radially expanded mechanical state leaves a gap **1180** ranging from 15% to 25% of the annulus **480**, and thus the remaining 15% to 25% must be closed with chemical expansion. What may result in one or more embodiments, after hydrolysis, is the expanded metal sealing/anchoring element **1175***a*, as shown in FIG. **11**C, or the expanded metal sealing/anchoring element having residual unreacted expandable metal therein **1175***b*, as shown in FIG. **11**D.

[0079] Turning to FIGS. **12**A through **12**D, depicted are various different deployment states for a scaling/anchoring tool **1200** designed, manufactured and operated according to an alternative embodiment of the disclosure. FIG. **12**A illustrates the sealing/anchoring tool **1200** in a run-in-hole state, and thus its scaling/anchoring element is in the radially reduced mechanical state, and furthermore the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **12**B illustrates the scaling/anchoring tool **1200** with its scaling/anchoring element in the radially enlarged mechanical state, but again the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **12**C illustrates the sealing/anchoring tool **1200** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal scaling/anchoring element (e.g., the sealing/anchoring element post-expansion). In contrast, FIG. **12**D illustrates the scaling/anchoring tool **1200** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element having residual unreacted expandable metal therein (e.g., the scaling/anchoring element post-expansion). As disclosed above, the expandable metal may be subjected to a suitable reactive fluid within the wellbore, thereby forming the expanded metal scaling/anchoring element.

[0080] The sealing/anchoring tool **1200** is similar in certain respects to the scaling/anchoring tool **1000**. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The scaling/anchoring tool **1200** differs, for the most part, from the scaling/anchoring tool **1000**, in that the sealing/anchoring tool **1200** employs a scaling/anchoring element **1220** including a circlet **1230** that comprises a wire of expandable metal, for example as discussed above. In the illustrated embodiment, the wire of expandable metal wraps around the hydraulically deformable member **1010**, and provides the geometric features necessary to allow it to mechanically deform when the hydraulically deformable member is moved from a radially reduced mechanical state to a radially enlarged mechanical state. While a single wire of expandable metal may be used, in certain other embodiments a plurality of different wires of expandable metal may be used. In certain embodiments, the wire of expandable metal has a higher surface-area-to-volume ratio (SA:V) than many of the embodiments discussed above, and thus might react faster to the reactive fluid than certain of the other embodiments. What may result in one or more embodiments, after hydrolysis, is the expanded metal scaling/anchoring element **1275***a*, as shown in FIG. **12**C, or the expanded metal sealing/anchoring element having residual unreacted expandable metal therein **1275***b*, as shown in FIG. **12**D.

[0081] Turning to FIGS. **13**A through **13**D, depicted are various different deployment states for a sealing/anchoring tool **1300** designed, manufactured and operated according to an alternative embodiment of the disclosure. FIG. **13**A illustrates the scaling/anchoring tool **1300** in a run-in-hole state, and thus its sealing/anchoring element is in the radially reduced mechanical state, and furthermore the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **13**B illustrates the sealing/anchoring tool **1300** with its sealing/anchoring element in the radially enlarged mechanical state, but again the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **13**C illustrates the sealing/anchoring tool **1300** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element (e.g., the sealing/anchoring element post-expansion). In contrast, FIG. **13**D illustrates the sealing/anchoring tool **1300** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element having residual unreacted expandable metal therein (e.g., the sealing/anchoring element post-expansion). As disclosed above, the expandable metal may be subjected to a suitable reactive fluid within the wellbore, thereby forming the expanded metal sealing/anchoring element.

[0082] The sealing/anchoring tool **1300** is similar in certain respects to the sealing/anchoring tool **1000**. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The scaling/anchoring tool **1300** differs, for the most part, from the sealing/anchoring tool **1000**, in that the sealing/anchoring tool **1300** employs a sealing/anchoring element **1320** including a circlet **1330** that comprises a collection of individual separate chunks of the expandable metal held together with a binding agent. What may result in one or more embodiments, after hydrolysis, is the expanded metal sealing/anchoring element **1375***a*, as shown in FIG. **13**C, or the expanded metal sealing/anchoring element having residual unreacted expandable metal therein **1375***b*, as shown in FIG. **13**D.

[0083] Turning to FIGS. **14**A through **14**D, depicted are various different deployment states for a sealing/anchoring tool **1400** designed, manufactured and operated according to an alternative embodiment of the disclosure. FIG. **14**A illustrates the scaling/anchoring tool **1400** in a run-in-hole state, and thus its sealing/anchoring element is in the radially reduced mechanical state, and furthermore the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **14**B illustrates the sealing/anchoring tool **1400** with its sealing/anchoring element in the radially enlarged mechanical state, but again the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **14**C illustrates the sealing/anchoring tool **1400** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element (e.g., the sealing/anchoring element post-expansion). In contrast, FIG. **14**D illustrates the sealing/anchoring tool **1400** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element having residual unreacted expandable metal therein (e.g., the sealing/anchoring element post-expansion). As disclosed above, the expandable metal may be subjected to a suitable reactive fluid within the wellbore, thereby forming the expanded metal sealing/anchoring element.

[0084] The sealing/anchoring tool **1400** is similar in certain respects to the sealing/anchoring tool **1000**. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The sealing/anchoring tool **1400** differs, for the most part, from the scaling/anchoring tool **1000**, in that the sealing/anchoring tool **1400** employs a sealing/anchoring element **1420** including a circlet **1430** that comprises a collection of individual separate chunks of the expandable metal held together within a fluid tight enclosure. The fluid tight enclosure, in at least one embodiment, may be punctured when the hydraulically deformable member **1010** moves from the radially reduced mechanical state to the radially expanded mechanical state, thereby exposing the collection of individual separate chunks of the expandable metal to the reactive fluid. What may result in one or more embodiments, after hydrolysis, is the expanded metal sealing/anchoring element **1475***a*, as shown in FIG. **14**C, or the expanded metal sealing/anchoring element having residual unreacted expandable metal therein **1475***b*, as shown in FIG. **14**D.

[0085] Turning to FIGS. **15**A through **15**D, depicted are various different deployment states for a sealing/anchoring tool **1500** designed, manufactured and operated according to an alternative embodiment of the disclosure. FIG. **15**A illustrates the sealing/anchoring tool **1500** in a run-in-hole state, and thus its sealing/anchoring element is in the radially reduced mechanical state, and furthermore the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **15**B illustrates the sealing/anchoring tool **1500** with its sealing/anchoring element in the radially enlarged mechanical state, but again the expandable metal has not been subjected to reactive fluid to begin hydrolysis. In contrast, FIG. **15**C illustrates the sealing/anchoring tool **1500** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal scaling/anchoring element (e.g., the sealing/anchoring element post-expansion). In contrast, FIG. **15**D illustrates the sealing/anchoring tool **1500** with its radially enlarged sealing/anchoring element having been subjected to reactive fluid, and thus starting the hydrolysis reaction, thereby forming an expanded metal sealing/anchoring element having residual unreacted expandable metal therein (e.g., the sealing/anchoring element post-expansion). As disclosed above, the expandable metal may be subjected to a suitable reactive fluid within the wellbore, thereby forming the expanded metal sealing/anchoring element.

[0086] The sealing/anchoring tool **1500** is similar in certain respects to the sealing/anchoring tool **1000**. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The sealing/anchoring tool **1500** differs, for the most part, from the sealing/anchoring tool **1000**, in that the sealing/anchoring tool **1500** employs a scaling/anchoring element **1520** including a circlet **1530** that comprises a collection of individual separate chunks of the expandable metal held together within a fluid penetrable cage. What may result in one or more embodiments, after hydrolysis, is the expanded metal sealing/anchoring element **1575***a*, as shown in FIG. **15**C, or the expanded metal sealing/anchoring element having residual unreacted expandable metal therein **1575***b*, as shown in FIG. **15**D.

[0087] Aspects disclosed herein include: [0088] A. A scaling/anchoring element for use with a sealing/anchoring tool, the scaling/anchoring element including: 1) a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet having one or more geometric features that allow it to mechanically deform when moved from a radially reduced mechanical state to a radially enlarged mechanical state, the circlet comprising an expandable metal configured to expand in response to hydrolysis to chemically deform the circlet from a radially reduced chemical state to a radially enlarged chemical state. [0089] B. A sealing/anchoring tool, the sealing/anchoring tool including: 1) a mandrel; 2) a wedge positioned about the mandrel; and 3) a sealing/anchoring element positioned about the mandrel and proximate the wedge, the sealing/anchoring element including: a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet having one or more geometric features that allow it to mechanically deform when moved from a radially reduced mechanical state to a radially enlarged mechanical state, the circlet comprising an expandable metal configured to expand in response to hydrolysis to chemically deform the circlet from a radially reduced chemical state to a radially enlarged chemical state. [0090] C. A well system, the well system including: 1) a wellbore; 2) a sealing/anchoring tool positioned within the wellbore, the sealing/anchoring tool including: a) a mandrel; b) a wedge positioned about the mandrel; and c) a sealing/anchoring element positioned about the mandrel and proximate the wedge, the sealing/anchoring element including: a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet having one or more geometric features that allow it to mechanically deform when moved from a radially reduced mechanical state to a radially enlarged mechanical state, the circlet comprising an expandable metal configured to expand in response to hydrolysis to chemically deform the circlet from a radially reduced chemical state to a radially enlarged chemical state. [0091] D. A method for sealing/anchoring within a wellbore, the method including: 1) providing a sealing/anchoring tool within a wellbore, the scaling/anchoring tool including: a) a mandrel; b) a wedge positioned about the mandrel; and c) a sealing/anchoring element positioned about the mandrel and proximate the wedge, the sealing/anchoring element including: a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet having one or more geometric features that allow it to mechanically deform when moved from a radially reduced mechanical state to a radially enlarged mechanical state, the circlet comprising an expandable metal configured to expand in response to hydrolysis to chemically deform the circlet from a radially reduced chemical state to a radially enlarged chemical state; 2) mechanically deforming the sealing/anchoring element by moving the circlet from the radially reduced mechanical state to the radially enlarged mechanical state; and 3) subjecting the mechanically deformed sealing/anchoring element in the radially enlarged mechanical state to reactive fluid to expand it to a radially enlarged chemical state and thereby form an expanded metal sealing/anchoring element. [0092] E. A scaling/anchoring tool, the sealing/anchoring tool including: 1) a mandrel; 2) a hydraulically deformable member positioned about the mandrel; and 3) a sealing/anchoring element positioned about the hydraulically deformable member, the sealing/anchoring element including: a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet comprising an expandable metal configured to expand in response to hydrolysis to chemically deform the circlet from a radially reduced chemical state to a radially enlarged chemical state. [0093] F. A well system, the well system including: 1) a wellbore; 2) a sealing/anchoring tool positioned within the wellbore, the sealing/anchoring tool including: a) a mandrel; b) a hydraulically deformable member positioned about the mandrel; and c) a sealing/anchoring element positioned about the hydraulically deformable member, the sealing/anchoring element including: a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet comprising an expandable metal configured to expand in response to hydrolysis to chemically deform the circlet from a radially reduced chemical state to a radially enlarged chemical state. [0094] G. A method for sealing/anchoring within a wellbore, the method including: 1) providing a sealing/anchoring tool within a wellbore, the sealing/anchoring tool including: a) a mandrel; b) a hydraulically deformable member positioned about the mandrel; and c) a positioned about the hydraulically deformable member, the sealing/anchoring element including: a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet comprising an expandable metal configured to expand in response to hydrolysis to chemically deform the circlet from a radially reduced chemical state to a radially enlarged chemical state; 2) mechanically deforming the sealing/anchoring element by moving the hydraulically deformable member from a radially reduced mechanical state to a radially enlarged mechanical state; and 3) subjecting the mechanically deformed sealing/anchoring element in the radially enlarged mechanical state to reactive fluid to expand it to the radially enlarged chemical state and thereby form an expanded metal sealing/anchoring element.

[0095] Aspects A, B, C, D, E, F and G may have one or more of the following additional elements in combination: Element 1: wherein the circlet is configured to mechanically deform from the radially reduced state to the radially enlarged state prior to chemically deforming the circlet from the radially reduced chemical state to the radially enlarged chemical state. Element 2: wherein the one or more geometric features are a full slot or partial slot in the wall thickness (t) of the circlet. Element 3: wherein the one or more geometric features are a full slot in the wall thickness (t) of the circlet that creates a C-ring. Element 4: wherein the one or more geometric features are a partial slot in the wall thickness (t) of the circlet including remaining material, the remaining material configured to snap when the circlet moves from the radially reduced mechanical state to the radially enlarged mechanical state. Element 5: wherein the circlet includes one or more angled surfaces positioned along its inside diameter (d.sub.i) or outside diameter (d.sub.o). Element 6: wherein the circlet includes one or more angled surfaces positioned along its inside diameter (d.sub.i) and outside diameter (d.sub.o), the one or more angled surfaces configured to engage with one or more associated angled surfaces to move the circlet from the radially reduced mechanical state to the radially enlarged mechanical state. Element 7: wherein the width (w) ranges from 0.3 meters to 1.2 meters. Element 8: wherein the width (w) is no greater than 2.54 cm. Element 9: wherein the thickness (t) ranges from 15 centimeters to 6 centimeters. Element 10: wherein the circlet has one or more geometric features that allow it to mechanically deform when moved from a radially reduced mechanical state to a radially enlarged mechanical state. Element 11: wherein the circlet is configured to mechanically deform from the radially reduced state to the radially enlarged state prior to chemically deforming from the radially reduced chemical state to the radially enlarged chemical state. Element 12: wherein the one or more geometric features are a full slot or partial slot

in the wall thickness (t) of the circlet. Element 13: wherein the one or more geometric features are a full slot in the wall thickness (t) of the circlet that creates a C-ring. Element 14: wherein the one or more geometric features are a partial slot in the wall thickness (t) of the circlet including remaining material, the remaining material configured to snap when the circlet moves from the radially reduced mechanical state to the radially enlarged mechanical state. Element 15: wherein the hydraulically deformable member is a bladder. Element 16: wherein the hydraulically deformable member is a limited expansion hydraulically deformable member, the limited expansion hydraulically deformable member configured to prevent the circlet from contacting a bore when the hydraulically deformable member moves from a radially reduced mechanical state to a radially enlarged mechanical state. Element 17: wherein the circlet is a wire of expandable metal. Element 18: wherein the mandrel includes one or more openings therein for supplying fluid to deploy the hydraulically deformable member from a radially reduced mechanical state to a radially expanded mechanical state.
[0096] Those skilled in the art to which this application relates will appreciate that other and further additions, deletions, substitutions and modifications may be made to the described embodiments.

Claims

1. A sealing/anchoring element for use with a sealing/anchoring tool, comprising: a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet having one or more geometric features that allow it to mechanically deform when moved from a radially reduced mechanical state to a radially enlarged mechanical state, the circlet comprising an expandable metal configured to expand in response to hydrolysis to chemically deform the circlet from a radially reduced chemical state to a radially enlarged chemical state.
2. The sealing/anchoring element as recited in claim 1, wherein the circlet is configured to mechanically deform from the radially reduced state to the radially enlarged state prior to chemically deforming the circlet from the radially reduced chemical state to the radially enlarged chemical state.
3. The sealing/anchoring element as recited in claim 1, wherein the one or more geometric features are a full slot or partial slot in the wall thickness (t) of the circlet.
4. The sealing/anchoring element as recited in claim 3, wherein the one or more geometric features are a full slot in the wall thickness (t) of the circlet that creates a C-ring.
5. The sealing/anchoring element as recited in claim 3, wherein the one or more geometric features are a partial slot in the wall thickness (t) of the circlet including remaining material, the remaining material configured to snap when the circlet moves from the radially reduced mechanical state to the radially enlarged mechanical state.
6. The sealing/anchoring element as recited in claim 1, wherein the circlet includes one or more angled surfaces positioned along its inside diameter (d.sub.i) or outside diameter (d.sub.o).
7. The sealing/anchoring element as recited in claim 1, wherein the circlet includes one or more angled surfaces positioned along its inside diameter (d.sub.i) and outside diameter (d.sub.o), the one or more angled surfaces configured to engage with one or more associated angled surfaces to move the circlet from the radially reduced mechanical state to the radially enlarged mechanical state.
8. The sealing/anchoring element as recited in claim 1, wherein the width (w) ranges from 0.3 meters to 1.2 meters.
9. The sealing/anchoring element as recited in claim 1, wherein the width (w) is no greater than 2.54 cm.
10. The sealing/anchoring element as recited in claim 1, wherein the thickness (t) ranges from 15 centimeters to 6 centimeters.

11. A sealing/anchoring tool, comprising: a mandrel; a wedge positioned about the mandrel; and a sealing/anchoring element positioned about the mandrel and proximate the wedge, the sealing/anchoring element including: a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet having one or more geometric features that allow it to mechanically deform when moved from a radially reduced mechanical state to a radially enlarged mechanical state, the circlet comprising an expandable metal configured to expand in response to hydrolysis to chemically deform the circlet from a radially reduced chemical state to a radially enlarged chemical state.
12. The sealing/anchoring tool as recited in claim 11, wherein the circlet is configured to mechanically deform from the radially reduced state to the radially enlarged state prior to chemically deforming the circlet from the radially reduced chemical state to the radially enlarged chemical state.
13. The sealing/anchoring tool as recited in claim 11, wherein the one or more geometric features are a full slot or partial slot in the wall thickness (t) of the circlet.
14. The sealing/anchoring tool as recited in claim 13, wherein the one or more geometric features are a full slot in the wall thickness (t) of the circlet that creates a C-ring.
15. The sealing/anchoring tool as recited in claim 13, wherein the one or more geometric features are a partial slot in the wall thickness (t) of the circlet including remaining material, the remaining material configured to snap when the circlet moves from the radially reduced mechanical state to the radially enlarged mechanical state.
16. The sealing/anchoring tool as recited in claim 11, wherein the circlet includes one or more angled surfaces positioned along its inside diameter (d.sub.i) or outside diameter (d.sub.o).
17. The sealing/anchoring tool as recited in claim 11, wherein the circlet includes one or more angled surfaces positioned along its inside diameter (d.sub.i) and outside diameter (d.sub.o), the one or more angled surfaces configured to engage with one or more associated angled surfaces to move the circlet from the radially reduced mechanical state to the radially enlarged mechanical state.
18. The sealing/anchoring tool as recited in claim 11, wherein the width (w) ranges from 0.3 meters to 1.2 meters.
19. The sealing/anchoring tool as recited in claim 11, wherein the width (w) is no greater than 2.54 cm.
20. The sealing/anchoring tool as recited in claim 11, wherein the thickness (t) ranges from 15 centimeters to 6 centimeters.
21. A well system, comprising: a wellbore; a sealing/anchoring tool positioned within the wellbore, the sealing/anchoring tool including: a mandrel; a wedge positioned about the mandrel; and a sealing/anchoring element positioned about the mandrel and proximate the wedge, the sealing/anchoring element including: a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet having one or more geometric features that allow it to mechanically deform when moved from a radially reduced mechanical state to a radially enlarged mechanical state, the circlet comprising an expandable metal configured to expand in response to hydrolysis to chemically deform the circlet from a radially reduced chemical state to a radially enlarged chemical state.
22. A method for sealing/anchoring within a wellbore, comprising: providing a sealing/anchoring tool within a wellbore, the sealing/anchoring tool including: a mandrel; a wedge positioned about the mandrel; and a sealing/anchoring element positioned about the mandrel and proximate the wedge, the sealing/anchoring element including: a circlet having an inside surface having an inside diameter (d.sub.i), an outside surface having an outside diameter (d.sub.o), a width (w), and a wall thickness (t), the circlet having one or more geometric features that allow it to mechanically deform when moved from a radially reduced mechanical state to a radially enlarged mechanical state, the circlet comprising an expandable metal configured to expand in response to hydrolysis to

chemically deform the circlet from a radially reduced chemical state to a radially enlarged chemical state; mechanically deforming the sealing/anchoring element by moving the circlet from the radially reduced mechanical state to the radially enlarged mechanical state; and subjecting the mechanically deformed sealing/anchoring element in the radially enlarged mechanical state to reactive fluid to expand it to a radially enlarged chemical state and thereby form an expanded metal sealing/anchoring element.