

are dramatically different from those of other metal foams currently being produced, there are sure to be many other interesting discoveries as more applications are investigated. [NWJ](#)

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This research recently won an *R&D Magazine* 2005 R&D 100 Award. This award program, which each year recognizes the world's top 100 scientific and technological advances, is designed to honor significant commercial promise in products, materials, or processes developed by the international research and development community.

What are transition metals?

The elements in the periodic table are often divided into four categories: main group elements, transition metals, lanthanides, and actinides. The main group elements include the active metals in the two columns on the extreme left of the table and the metals, semimetals (metalloids), and nonmetals in the six columns on the far right.

The transition metals, or transition elements, are the metallic elements in the columns in the center of the table, forming a bridge or transition between the active metals on the left and the elements on the right.

Lanthanides and actinides are usually shown in two rows below the main table; they are sometimes called the inner transition metals because their atomic numbers fall between the first and second elements in the last two rows of the transition metals (after lanthanum and actinium, respectively).

Periodic Table of the Elements																			
1A																	8A		
1 H 1 hydrogen 1.008																	2 He 2 helium 4.003		
3 Li [He]2s ¹ lithium 6.941	4 Be [He]2s ² beryllium 9.012													5 B [He]2s ² 2p ¹ boron 10.81	6 C [He]2s ² 2p ² carbon 12.01	7 N [He]2s ² 2p ³ nitrogen 14.01	8 O [He]2s ² 2p ⁴ oxygen 16.00	9 F [He]2s ² 2p ⁵ fluorine 19.00	10 Ne [He]2s ² 2p ⁶ neon 20.18
11 Na [Ne]3s ¹ sodium 22.99	12 Mg [Ne]3s ² magnesium 24.31													13 Al [Ne]3s ² 3p ¹ aluminum 26.98	14 Si [Ne]3s ² 3p ² silicon 28.09	15 P [Ne]3s ² 3p ³ phosphorus 30.97	16 S [Ne]3s ² 3p ⁴ sulfur 32.07	17 Cl [Ne]3s ² 3p ⁵ chlorine 35.45	18 Ar [Ne]3s ² 3p ⁶ argon 39.95
19 K [Ar]4s ¹ potassium 39.10	20 Ca [Ar]4s ² calcium 40.08	21 Sc [Ar]4s ¹ 3d ¹ scandium 44.96	22 Ti [Ar]4s ² 3d ² titanium 47.88	23 V [Ar]4s ¹ 3d ³ vanadium 50.94	24 Cr [Ar]4s ¹ 3d ⁵ chromium 52.00	25 Mn [Ar]4s ² 3d ⁵ manganese 54.94	26 Fe [Ar]4s ² 3d ⁶ iron 55.85	27 Co [Ar]4s ¹ 3d ⁷ cobalt 58.93	28 Ni [Ar]4s ² 3d ⁸ nickel 58.69	29 Cu [Ar]4s ¹ 3d ¹⁰ copper 63.55	30 Zn [Ar]4s ² 3d ¹⁰ zinc 65.39	31 Ga [Ar]4s ² 4p ¹ 3d ¹⁰ gallium 69.72	32 Ge [Ar]4s ² 4p ² 3d ¹⁰ germanium 72.58	33 As [Ar]4s ² 4p ³ 3d ¹⁰ arsenic 74.92	34 Se [Ar]4s ² 4p ⁴ 3d ¹⁰ selenium 78.96	35 Br [Ar]4s ² 4p ⁵ 3d ¹⁰ bromine 79.90	36 Kr [Ar]4s ² 4p ⁶ 3d ¹⁰ krypton 83.80		
37 Rb [Kr]5s ¹ rubidium 85.47	38 Sr [Kr]5s ² strontium 87.62	39 Y [Kr]5s ¹ 4d ¹ yttrium 88.91	40 Zr [Kr]5s ² 4d ² zirconium 91.22	41 Nb [Kr]5s ¹ 4d ⁴ niobium 92.91	42 Mo [Kr]5s ¹ 4d ⁵ molybdenum 95.94	43 Tc [Kr]5s ² 4d ⁵ technetium (98)	44 Ru [Kr]5s ¹ 4d ⁷ ruthenium 101.1	45 Rh [Kr]5s ¹ 4d ⁸ rhodium 102.9	46 Pd [Kr]5s ⁰ 4d ¹⁰ palladium 106.4	47 Ag [Kr]5s ¹ 4d ¹⁰ silver 107.9	48 Cd [Kr]5s ² 4d ¹⁰ cadmium 112.4	49 In [Kr]5s ² 4d ¹⁰ 5p ¹ indium 114.8	50 Sn [Kr]5s ² 4d ¹⁰ 5p ² tin 118.7	51 Sb [Kr]5s ² 4d ¹⁰ 5p ³ antimony 121.8	52 Te [Kr]5s ² 4d ¹⁰ 5p ⁴ tellurium 127.6	53 I [Kr]5s ² 4d ¹⁰ 5p ⁵ iodine 126.9	54 Xe [Kr]5s ² 4d ¹⁰ 5p ⁶ xenon 131.3		
55 Cs [Xe]6s ¹ cesium 132.9	56 Ba [Xe]6s ² barium 137.3	57 La* [Xe]6s ¹ 5d ¹ lanthanum 138.9	72 Hf [Xe]6s ² 4f ¹⁴ 5d ² hafnium 178.5	73 Ta [Xe]6s ² 4f ¹⁴ 5d ³ tantalum 180.9	74 W [Xe]6s ² 4f ¹⁴ 5d ⁴ tungsten 183.9	75 Re [Xe]6s ² 4f ¹⁴ 5d ⁵ rhenium 186.2	76 Os [Xe]6s ² 4f ¹⁴ 5d ⁶ osmium 190.2	77 Ir [Xe]6s ¹ 4f ¹⁴ 5d ⁷ iridium 190.2	78 Pt [Xe]6s ¹ 4f ¹⁴ 5d ⁹ platinum 195.1	79 Au [Xe]6s ¹ 4f ¹⁴ 5d ¹⁰ gold 197.0	80 Hg [Xe]6s ² 4f ¹⁴ 5d ¹⁰ mercury 200.5	81 Tl [Xe]6s ² 4f ¹⁴ 5d ¹⁰ 6p ¹ thallium 204.4	82 Pb [Xe]6s ² 4f ¹⁴ 5d ¹⁰ 6p ² lead 207.2	83 Bi [Xe]6s ² 4f ¹⁴ 5d ¹⁰ 6p ³ bismuth 208.9	84 Po [Xe]6s ² 4f ¹⁴ 5d ¹⁰ 6p ⁴ polonium (209)	85 At [Xe]6s ² 4f ¹⁴ 5d ¹⁰ 6p ⁵ astatine (210)	86 Rn [Xe]6s ² 4f ¹⁴ 5d ¹⁰ 6p ⁶ radon (222)		
87 Fr [Rn]7s ¹ francium (223)	88 Ra [Rn]7s ² radium (226)	89 Ac~ [Rn]7s ¹ 6d ¹ actinium (227)	104 Rf [Rn]7s ² 5f ¹⁴ 6d ² rutherfordium (261)	105 Db [Rn]7s ² 5f ¹⁴ 6d ³ dubnium (260)	106 Sg [Rn]7s ² 5f ¹⁴ 6d ⁴ seaborgium (263)	107 Bh [Rn]7s ² 5f ¹⁴ 6d ⁵ bohrium (262)	108 Hs [Rn]7s ² 5f ¹⁴ 6d ⁶ hassium (265)	109 Mt [Rn]7s ² 5f ¹⁴ 6d ⁷ meitnerium (266)	110 Ds [Rn]7s ² 5f ¹⁴ 6d ⁸ darmstadtium (271)	111 Uuu (272)	112 Uub (277)	114 Uuq (296)	116 Uuh (298)	118 Uuo (?)					
Lanthanide Series		58 Ce [Xe]6s ¹ 4f ¹ cerium 140.1	59 Pr [Xe]6s ¹ 4f ³ praseodymium 140.9	60 Nd [Xe]6s ¹ 4f ⁴ neodymium 144.2	61 Pm [Xe]6s ¹ 4f ⁵ promethium (147)	62 Sm [Xe]6s ¹ 4f ⁶ samarium (150.4)	63 Eu [Xe]6s ¹ 4f ⁷ europium 152.0	64 Gd [Xe]6s ¹ 4f ⁷ 5d ¹ gadolinium 157.3	65 Tb [Xe]6s ¹ 4f ⁹ terbium 158.9	66 Dy [Xe]6s ¹ 4f ¹⁰ dysprosium 162.5	67 Ho [Xe]6s ¹ 4f ¹¹ holmium 164.9	68 Er [Xe]6s ¹ 4f ¹² erbium 167.3	69 Tm [Xe]6s ¹ 4f ¹³ thulium 168.9	70 Yb [Xe]6s ¹ 4f ¹⁴ ytterbium 173.0	71 Lu [Xe]6s ¹ 4f ¹⁴ 5d ¹ lutetium 175.0				
Actinide Series		90 Th [Rn]7s ² 6d ² thorium 232.0	91 Pa [Rn]7s ² 6d ¹ protactinium (231)	92 U [Rn]7s ² 6d ¹ uranium (238)	93 Np [Rn]7s ² 6d ¹ neptunium (237)	94 Pu [Rn]7s ² 6d ¹ plutonium (242)	95 Am [Rn]7s ² 6d ¹ americium (243)	96 Cm [Rn]7s ² 6d ¹ curium (247)	97 Bk [Rn]7s ² 6d ¹ berkelium (247)	98 Cf [Rn]7s ² 6d ¹ californium (249)	99 Es [Rn]7s ² 6d ¹ einsteinium (254)	100 Fm [Rn]7s ² 6d ¹ fermium (253)	101 Md [Rn]7s ² 6d ¹ mendelevium (256)	102 No [Rn]7s ² 6d ¹ nobelium (254)	103 Lr [Rn]7s ² 6d ¹ lawrencium (257)				