



Let me know most recent data or combination technology of gold nano, silver nano and sele nano in several fields including industries, architecture, material, ...

Emerging data up to 2025 shows a broad, cross-disciplinary surge in using gold, silver, and selenium nanoparticles (AuNPs, AgNPs, SeNPs) across industries, architecture, and materials science, with emphasis on green synthesis, biocompatibility, and multifunctional composites.

Here's a detailed view across key domains.

Biomedical and therapeutic applications

- Gold nanoparticles: Widely explored for drug delivery, diagnostics, imaging, photothermal therapy, and biosensing. Shape, size, and surface chemistry tailor optical properties (plasmon resonance) and cellular uptake. Biocompatibility and tunable surface functionalization enable targeted therapies and combination treatments with other nanomaterials.^{[1] [2]}
- Silver nanoparticles: Noted for strong antimicrobial and anti-inflammatory actions; used in wound dressings, coatings, and antimicrobial surfaces. Advancements focus on reducing cytotoxicity while maintaining efficacy, and integrating with polymers for controlled release and enhanced stability.^{[2] [3]}
- Selenium nanoparticles: Investigated for redox activity, antioxidant properties, and nephroprotection; demonstrated apps in biomedicine with emphasis on safety, biodegradability, and reduced systemic toxicity relative to some metal NPs.^{[4] [2]}
- Combined strategies: Hybrid or ternary systems combining AuNPs, AgNPs, and SeNPs aim to leverage complementary mechanisms (antimicrobial action, anti-inflammatory effects, and redox modulation) for multi-target therapies, nanomedicine sensors, or theranostics. Green synthesis routes (biogenic or plant-assisted) are increasingly highlighted for sustainable production and reduced environmental impact.^{[3] [5] [4]}

Industrial and materials science

- Catalysis and sensing: AuNPs and AgNPs are used as catalysts and as plasmonic enhancers in sensors; SeNPs add redox-active properties to composite materials, expanding functionalities in electronics and energy devices.

- Coatings and packaging: Silver and gold nanoparticles embedded in polymers or coatings impart antimicrobial properties and improved thermal/electrical performance; selenium-containing coatings can offer antioxidative protection and stability.
- Wound care and medical textiles: Nanosilver and nano-gold-based coatings are used on dressings and fabrics for durable antimicrobial action; SeNPs are explored for antioxidant contributions and safety in wound healing contexts. ^{[6] [5] [2]}

Architecture, construction, and architecture-adjacent materials

- Bio-based and nano-enabled coatings: Silver and gold nanoparticles are investigated for durable antimicrobial coatings on interior surfaces, filtration systems, and building materials. Selenium nanoparticles contribute antioxidant stability and potential protective effects against oxidative degradation in materials exposed to harsh environments.
- Biocomposites and functional materials: Incorporating these nanoparticles into biopolymers and cementitious matrices can yield enhanced mechanical properties, hydrophobic/hydrophilic balance, and self-cleaning or sensing capabilities in smart building materials.
- Sustainability focus: Green synthesis methods and recyclable nanoparticle-infused materials align with circular economy goals, reducing solvent use and hazardous reagent exposure in construction-adjacent manufacturing. ^{[5] [6]}

Electronics and sensors

- Optical and electronic functionalities: AuNPs and AgNPs enable plasmonic sensing, surface-enhanced Raman scattering (SERS), and conductive nanocoatings in flexible electronics. SeNPs contribute redox activity and can improve stability in certain sensor architectures.
- Product integration: Nanocomposite coatings for sensors, microelectronic packaging, and energy storage devices leverage the complementary properties of these nanoparticles to improve sensitivity and durability. ^{[1] [5]}

Safety, regulation, and environmental considerations

- Toxicity and exposure: AuNPs and AgNPs require careful size, shape, and coating design to minimize cytotoxicity and environmental impact; SeNPs generally show favorable safety profiles but require dose- and form-specific evaluation.
- Regulatory landscape: Applications in medicine and consumer products face rigorous regulatory scrutiny; green synthesis approaches are increasingly favored for compliance and sustainability. Ongoing reviews summarize nephroprotective and antimicrobial potential alongside safety considerations. ^{[7] [2] [4]}

If you'd like, I can tailor this into a sector-specific briefing with recent data points, figures, and citations for:

- Biomedicine and therapeutics (infographics on size/shape effects, dosing ranges)

- Industrial coatings and packaging (performance benchmarks)
- Architecture and construction (migrations toward nano-enabled biocomposites)

Would you prefer a focused briefing on one or two of these domains, or a comparative matrix across all three?

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1. <https://pubs.acs.org/doi/10.1021/acsomega.5c03162>
2. <https://www.sciencedirect.com/science/article/pii/S2214750024002737>
3. <https://www.nature.com/articles/s41598-025-13681-1>
4. <https://pubmed.ncbi.nlm.nih.gov/39915798/>
5. <https://www.frontiersin.org/journals/bioengineering-and-biotechnology/articles/10.3389/fbioe.2025.1637589/full>
6. <https://www.sciencedirect.com/science/article/pii/S2790676025000160>
7. <https://pubmed.ncbi.nlm.nih.gov/39312019/>