Plasmonic Metal Nitride and TCO Nanostructures

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- Green Technology
- Materials and Manufacturing

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- Nanoparticles
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Transition metal nitrides, such as titanium nitride (TiN) or zirconium nitride (ZrN), exhibit special properties under visible and near infrared light. For example, titanium nitride nanoparticles possess broad absorption peaks and form ohmic junctions with known photocatalysts, making them ideal for utilization in advanced photoelectric systems. In addition, the refractory properties of these metals make them durable at high temperatures with electromagnetic spectrum efficiencies comparable to gold. Optimization of these properties could be extremely beneficial for numerous applications.

Researchers at Purdue University have developed a process to optimize the growth parameters of titanium nitride nanoparticles for customization in advanced systems. Through nitridation or oxidation processes, the native oxide layers on TiN can be removed or extended respectively, adjusting the properties of the metal. Afterward, the plasmonic resonance and refractory properties of the nanoparticles can be applied in designs for plasmon-assisted catalysis and semiconductors used in solar energy conversion. This design includes the use of an inorganic nanocrystal, such as TiO2 or Al2O3, as support material, a plasmonic transition metal nitride nanoparticles deposited on the facets of the support, and a catalytic metallic shell made by Cu, Pt, or Pd, providing thermal and chemical protection.

Advantages:
-Broader absorption peak
-Ohmic junction
-Refraction
-Plasmonic resonance

Potential Applications:
-Transition metal nitride nanoparticles
-Semiconductors

-Catalysis

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