Radiation Curing Enhancement by Semiconducting Nanoparticles

Material Science

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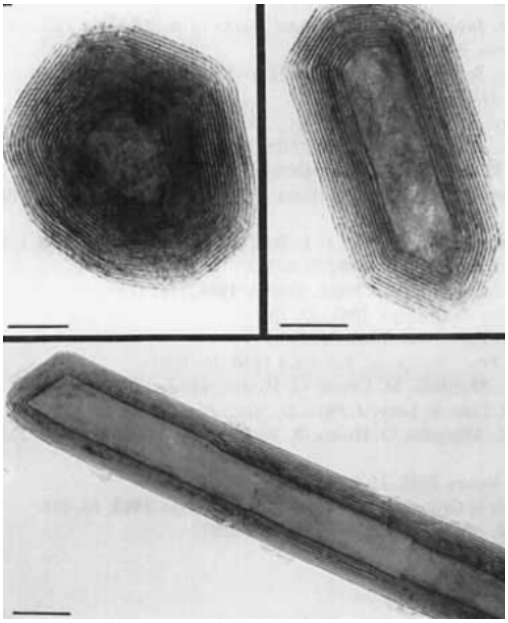
UV curing of polymers plays a critical role in technologies such as dentistry, advanced manufacturing (e.g., 3D printing), optical media production, and biotechnology. Traditional methods rely on UV irradiation of photoinitiators, but the resulting thermosets are often brittle and limited to thin, transparent formulations. This technology introduces semiconducting nanoparticles (e.g., WS_2) that generate radicals under UV light to initiate efficient polymerization and cross-linking, resulting in improved mechanical properties and broader applicability. Given their benign characteristics, they can be used also for reinforcing various biocompatible polymers used in medical technologies.



Electron micrographs of polyhedral nanocrystals of WS_2

APPLICATIONS

- Reinforcement of radiation curing of acrylates
- Cation-induced polymerization of epoxies for adhesives
- Matrices for fiber composites and 3D printing resins

DEVELOPMENT STAGE

The technology has been demonstrated with dispersed tungsten disulfide fullerene-like nanoparticles (WS_2-IF) in acrylate and epoxy resins photocuring, showing covalent bond formation between the nanopaticles and the matrix, resulting in improved adhesion and reduced viscosity.

DIFFERENTIATION

Enhances the mechanical properties (elasticity, yield strength, and elongation) of thermosetting polymer films

Increased film fracture toughness

Improved film peeling resistance, strength, and adhesion

Accelerated photocuring process

REFERENCES

- R. Tenne, et al, Adv. Mater. 1993