LuminaSand: Harnessing the Optoelectronic Potential of Silicon Dioxide With Focused Laser Beam

Ang, Georia (School: Hwa Chong Institution)

The increasing reliance on optoelectronic devices in communication, sensing, and display technologies has driven the search for alternative materials that are cost-effective, scalable, and highly efficient. Conventional optoelectronic materials, such as gallium arsenide and indium tin oxide, face challenges related to scarcity, high production costs, and environmental concerns. This study explores a simple alternative approach to fabricating silicon-carbon nanotube (SiCNT) based composite material for optoelectronic application through laser-initiated rapid annealing and quenching. The site-specific laser treatment process induces localised suspended SiCNT structure and cyan fluorescence under ultra-violet excitation. Comparisons between laser treatment in ambient versus vacuum environment identified oxygen defects as the likely contributor to the observed cyan fluorescence. This laser-transformed composite material achieves an ~82,000-fold increase in electrical conductivity compared to its pristine state. Device testing further elucidates its capability to effectively generate photocurrent, particularly with a 532 nm monochromatic laser. This work highlights the potential of rapid laser-initiated transformation of SiCNT composite as an economical and scalable optoelectronic material, offering a promising alternative for future technological applications.

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