Tailored Nanozyme Composite Materials via Laser Ablation in Liquid: Towards Enhanced Photocatalytic and Antimicrobial Capabilities

Angela De Bonis[1,*], Mariangela Curcio[1], Michela Marsico[1], Agostino Galasso[1], Antonio Santagata [2] and Roberto Teghil[1]

[1] Dipartimento di Scienze, Università della Basilicata, Viale dell'Ateneo Lucano, 10 – 85100 Potenza, Italy
[2] ISM-CNR, UOS Tito Scalo, C.da Santa Loja, Tito Scalo (PZ), Italy
*Corresponding author email: angela.debonis@unibas.it

Nanozymes are nanoscale enzyme mimics. Nanozymes based on noble metals, oxides and carbon based nanostructures have been widely used in different applications including biosensing, cancer therapies and pollution removal. Laser ablation in liquid (LAL) has garnered significant attention in recent years as valuable technique to control the dimension and surface composition of nanomaterials and to prepare polymeric composite system in a simple one pot synthetic strategy. In this work, we have prepared nanocomposites with potential nanozyme capability, i.e. cerium oxide, palladium and silver nanoparticles dispersed in polymer, as collaborative platform with plasmonic, photothermal and photocatalytic properties.
The catalytic capability of the active components in the collaborative platform has been tailored with biocompatible and functional polymers such chitosan
The chitosan concentration, solution pH and laser parameters (such as wavelenghth, energy and pulse length) have been varied to optimize nanocomposite functional properties. Characterization techniques including Transmission Electron Microscopy (TEM), X-ray Diffraction (XRD), Fourier-Transform Infrared Spectroscopy (FTIR), micro Raman and X-ray Photoelectron Spectroscopy (XPS) were considered to characterize the morphology, size distribution, composition and crystallinity of the fabricated composites.

The results demonstrate the feasibility of LAL for the preparation of chitosan/metal composite materials with tailored properties, including improved photocatalytic activity and enhanced antimicrobial activity. These composite materials hold significant potential for applications in wound healing, tissue engineering and environmental remediation.

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