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Enhanced Functional Surface Induced by Laser Micro/Nano-Manufacturing for Environmental Applications

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Abstract – This presentation explores the application of laser micro/nano-manufacturing in environmental engineering, focusing on oil/water separation, photocatalytic degradation, and surface-enhanced Raman scattering (SERS). Laser processing technology, characterized by high precision, velocity, and reliability, is employed to fabricate various functional surfaces and nanomaterials. For oil/water separation, laser-ablated copper meshes with different surface modifications, such as the deposition of graphene oxide or the growth of CuO nanowires, show excellent separation performance and environmental stability. In photocatalysis, ZnO nanowires, Ag/TiO_2 composites, and N-doped TiO_2 hollow microspheres fabricated by laser hybrid processing exhibit high photocatalytic activities for degrading organic pollutants and purifying water. Regarding SERS, different SERS substrates like Si-based nanostructures and cauliflower-like superhydrophobic substrates are fabricated via laser ablation, enabling highly sensitive detection of pollutants. These research results not only demonstrate the great potential of laser micro/nano-manufacturing in environmental applications but also provide effective solutions for environmental pollution problems, which is of great significance for promoting the development of environmental materials and devices.