DIPARTIMENTO DI SCIENZE MATEMATICHE E INFORMATICHE, SCIENZE FISICHE E SCIENZE DELLA TERRA
Dottorato di Ricerca in Fisica

Appunti di Fisica '21

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webinar su Microsoft Teams

From a catalogue of metastable nanoalloys to the study of the structure-property relationship for nanomedicine, plasmonics or catalysis

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Alloy nanoparticles containing noble and transition metals are appealing for a series of applications and fundamental studies in catalysis, optics and nanomedicine. However, the thermodynamics is unfavorable to the largest part of these alloys, which can be obtained only by non-equilibrium routes. To this end, laser ablation in liquid (LAL) is a powerful technique for the synthesis of metal alloys, also with thermodynamically forbidden composition. By mastering the LAL synthesis, a whole catalogue of alloys is accessible for fundamental studies about the structural motifs adopted by elements frozen at the nanoscale and the consequent set of physical-chemical properties. The insights on the structure-properties relation provided the basis for further optimization of the nanoalloys for specific applications. The cases of Y alloys designed to climb the volcano plot for oxygen reduction catalysis, Ag alloys where the coexistence of magnetic and plasmonic properties is maximized, and noble metal alloys acting as 4-D multimodal contrast agents with enhanced clearance from the body will be discussed. Though not yet optimal for real-world applications, these nanosystems provided clear directions for further development of the intended functionalities, which are the subject of ongoing efforts. Hence, this is a general demonstration of the range of innovative results and functional optimization expected by the synergy between LAL synthesis, structural modelling, and experimental verification of functional properties in nonequilibrium nanoalloys.

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