Porosity-moderated ultrafast electron transport in Au nanowire networks

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We demonstrate for the first time the ultrafast properties of a newly formed porous Au nanostructure (Fig 1-up-left). The properties of the porous nanostructure are compared with those of a solid gold film using time-resolved optical spectroscopy. The experiments suggest that under the same excitation conditions the relaxation dynamics are slower in the former (Fig. 1-up-right). Our observations are evaluated by simulations based on a phenomenological rate equation model (Fig.1 down-left). The impeded dynamics has been attributed to the porous nature of the structure in the networks, which results in reduced efficiency during the dissipation of the laser-deposited energy. Importantly, the porosity of the complex three-dimensional nanostructure is introduced as a geometrical control parameter of its ultrafast electron transport. [1]. The results are of great importance to modern applications in photovoltaics, nanocircuits and nanocatalysts where the active elements are based on extended size three-dimensional porous nanostructures.

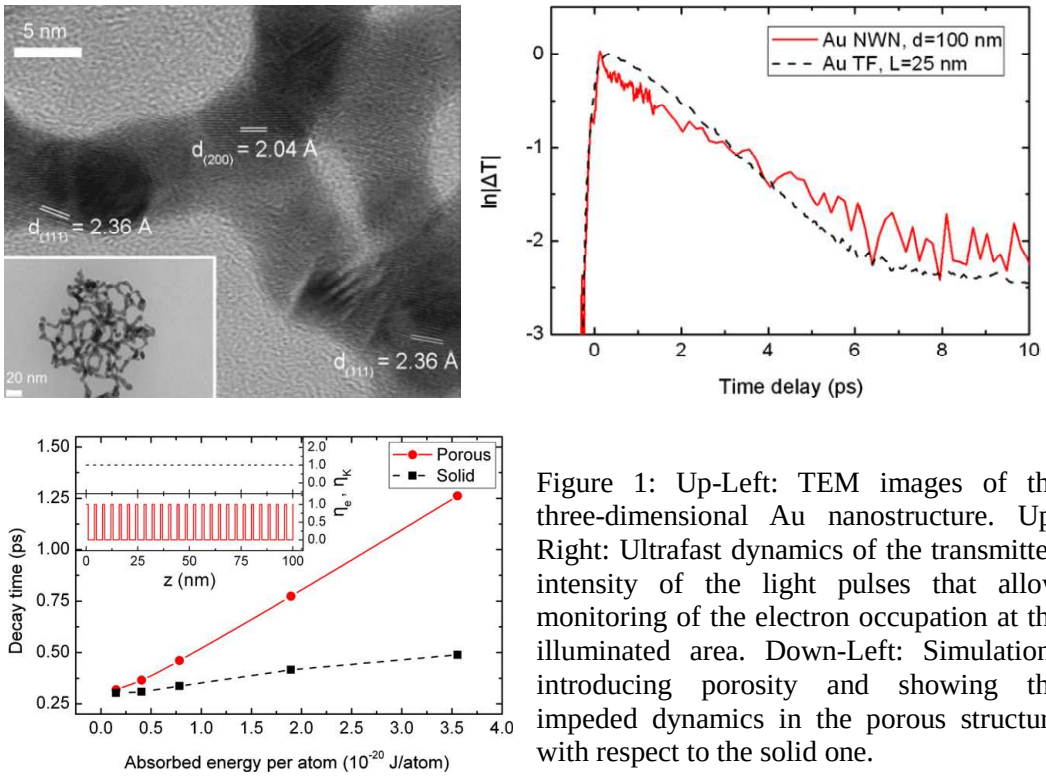

Figure 1: Up-Left: TEM images of the three-dimensional Au nanostructure. Up-Right: Ultrafast dynamics of the transmitted intensity of the light pulses that allow monitoring of the electron occupation at the illuminated area. Down-Left: Simulations introducing porosity and showing the impeded dynamics in the porous structure with respect to the solid one.

References

[1] E. Magoulakis, A. Kostopoulou, G.N. Arvanitakis, A.G. Kanaras, A.N. Andriotis, A. Lappas, P.A. Loukakos, Appl. Phys. A **111**, 711 (2013).

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