【Integrated Science and Innovative Science（New multidisciplinary fields）】

Architectonics of metallic nano-materials and infrared plasmons

Tadaaki Nagao

(National Institute for Materials Science, Materials Nanoarchitectonics,
Independent Young Scientist)

【Outline of survey】

In metallic material, electron system oscillates in a collective manner with ultrahigh frequencies. This oscillation is called plasmon and the world-wide active research field has emerged recently that aims at controlling the propagation, scattering, and the polarization of light in nanometer scale, by utilizing the coupling between the plasmon near the surface and external photon field. Normally, the plasmon frequency lies in visible to ultraviolet regime, but when the object shape becomes atomically thin, and the interaction between the objects becomes significant, the oscillation frequency shifts downwards to the infrared regime or lower with tiny nano-scale propagation wavelength.

In this project, we will establish the way for applying this novel knowledge for the realization of new classes of optical materials. We will explore various nano-metallic architecture, by adopting nanofabrication, colloidal process, as well as molecular atomic-layer epitaxy. In this way, we will establish a new methodology, which can be called as “nano-plasmotectonics”, for realizing innovative infrared optical materials.

【Expected results】

The optical functional properties explored here fits to the spectral region which is important in the field of environment, bio-sensing, and energy, and also matches to the requirement for the miniaturization of the future opto-electronic devices. Therefore, the outcomes from this project are highly expected to be applied in various fields as the evolution of nanotechnology proceeds. In the present project, along with the materials development, we will also develop new nano-measurement techniques and will feedback these results bidirectionally which should be highly effective in establishing the original methodology for developing innovative optical materials. In this way, we believe we can open the way for designing and realizing novel low-frequency plasmonic materials.

【References by the principal investigator】

・D. Enders, **T. Nagao**, and T. Nakayama, and M. Aono, “Precisely Controlled Fabrication of Highly Sensitive Au Sensor Film for Surface Enhanced Spectroscopy,” Japanese Journal of Applied Physics **49** (Express Letters), L1222-1224 (2007).

・**T. Nagao**, S. Yaginuma, T. Inaoka, and T. Sakurai, 'One-dimensional plasmon in atom wire array,' *Physical Review Letters*, 97, (2006) 116802.

・**T. Nagao**, 'Effects of the change in dimensionality on plasmons in metallic nanomaterials,' *OYO BUTURI*, 73, 1312-1318(2004) (front cover article).

【Term of project】 FY2008－2012	【Budget allocation】 **88,900,000 yen** (direct cost)

【Homepage address】

http://www.nims.go.jp/mana/members/young_scientist/t_nagao/index.html