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Title:	Analysis of electronic state from the interface of stepped Au/TiO_2 (320) interface by SHG technique in terms of azimuthal angle, in-out polarization and wavelength
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Abstract:

In modern world, the research on catalytic field is rich enough. The Au/TiO_2 combination is a well-known catalyst and plays an important role due to an extraordinary high activity for many chemical reactions such as low-temperature catalytic combustion, partial oxidation of hydrocarbons, hydrogenation of unsaturated hydrocarbons, and reduction of nitrogen oxides and so on. Studying the electronic states of the Au/TiO_2 interface is vital to explore the catalytic mechanism. So, we intended to study the Au/TiO_2 (320) interface by second harmonic generation (SHG) technique for the first time. SHG is a well-established surface-specific probe of centrosymmetric media. In the dipole approximation, SHG is forbidden in the bulk of a medium having inversion symmetry, while at the surface inversion symmetry is broken and SHG is allowed. Au/TiO_2 steps should generate a SHG signal due to broken symmetry at the interface. The origin of the second order nonlinearity is the breaking of symmetry in the direction normal to the surface and direction parallel to the surface by atomic steps. The Au film with the thickness of 2 nm was deposited in a UHV chamber at a pressure of $2x10^{-7}$ Torr. We observed the SHG response from the Au/TiO_2 (320) interface and bare TiO_2 (320) using pulsed Nd^{2+} :YAG laser light at the photon energies of 1.17 eV and 2.33 eV. The isotropic response was found from both samples when we used photon energy of 1.17 eV nm. In contrast, we observed anisotropic response from both Au /TiO_2 (320) and bare TiO_2 (320) at the photon energy of 2.33 eV. From Au/TiO_2 (320) sample, an anisotropic structure was observed in the [$2\bar{}$30] direction for Pin/Pout polarization combination. We theoretically decomposed the nonlinear susceptibility elements and divided them into two groups such as step contribution and terrace contribution groups. According to the information of step and terrace contribution of nonlinear susceptibility elements, we intended to observe the actual resonance mode as a function of the wavelength that will help us to clarify catalytic mechanism and physics behind it.