

# ENHANCED SHG IMAGING OF SELF-ASSEMBLED MONOLAYER ON Pt SUBSTRATE VIA RADIALLY POLARIZED BEAM EXCITATION

Hirohiko Niioka<sup>1</sup>, Koichiro Ashida<sup>2</sup>, Keisuke Yoshiki<sup>3</sup>, Tsutomu Araki<sup>2</sup>, Mamoru Hashimoto<sup>2</sup>

<sup>1</sup>Institute for Nanoscience Design, Osaka University

<sup>2</sup>Graduate School of Engineering Science, Osaka University  
1-3 Machikaneyama, Toyonaka, Osaka 560-8531, Japan

<sup>3</sup>Graduate School of Engineering University of Hyogo, Japan  
2167 Syosya, Himeji, Hyogo 671-2201, Japan

E-mail: niioka@insd.osaka-u.ac.jp

**KEY WORDS:** SHG, Imaging, Radially polarized beam, Self-Assembled Monolayer (SAM)

P-polarized light generates strong electrical field on the vicinity of metal substrate due to interference between irradiated and reflected light. This technique has been utilized to effectively detect organic molecules on metal substrate though the spatial resolution is restricted because the incident angle has to be large to obtain strong electrical field.

For high sensitive measurement of molecules on the metal substrate with microscopic resolution, we applied a radially polarized beam for excitation<sup>1)</sup>. A focused radially polarized beam concentrates p-polarized light, then enhanced electrical field is generated at the focus spot. With the combination of the field enhancement and SHG microscopy due to its inherent surface sensitivity, enhanced SHG imaging of Self-Assembled Monolayer (SAM) on Pt substrate was realized (Fig. 1 (a)). Though the SAM has only single molecular thickness, the lattice-patterned SAM was clearly observed by using a radially polarized beam, in the contrast to using a linearly polarized beam. Furthermore the point-spread function on metal substrate is sharpen by using the radially beam, hence the improved resolution of the image was confirmed. For the preparation of SAM, DACITC (7-dimethylamino-4-methylcoumarin-3-isothiocyanate) was used.

Figure 1 (b) shows the SHG intensity from SAM and Pt substrate depend on the polarization of irradiated laser light. Radially polarized beam enhanced the signal from SAM approximately 4 times than that excited with linearly polarized light. And SHG intensity from Pt substrate itself was negligible small.

This enhancement technique might be applied to all metal substrates, and does not require Ag and Au that are utilized for surface plasmon resonance microscopy. Due to the enhancement of electrical field, it should be possible to enhance another optical effects especially higher order nonlinear effects.

1) M. Hashimoto, K. Ashida, K. Yoshiki, and T. Araki, *Opt. Lett.*, **34**, 1423 (2009).

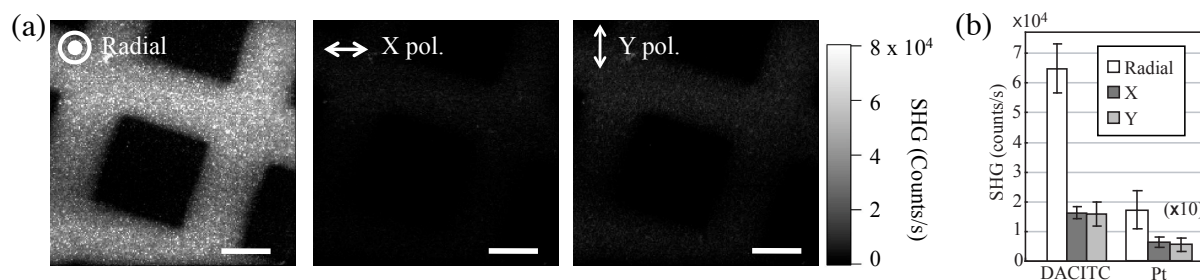


Fig. 1 (a) SHG image of SAM on Pt substrate. With using radially polarized beam SAM on Pt substrate was clearly observed rather than using linearly polarized light. The laser power was 13 mW. Exposure time was 5 ms / pixel. The image size is 200 x 200 pixels. Bar = 20  $\mu$ m. (b) SHG intensity depend on the polarization of irradiation laser light. (The intensities from Pt substrate are multiplied by 10)