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## 12.6 Recent work on laser-induced breakdown spectroscopy (LIBS) for surface analysis at PISCES

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We present our recent work on LIBS for surface analysis to better understand complicated plasma-material interactions. We have invented a novel technique, spatially-offset double-pulse (SODP) LIBS, for thin film measurements [1]. In this technique, two laser spots on a material surface are spatially offset by a few mm, while there is no spatial gap for the standard collinear DP-LIBS. Compared to DP-LIBS, SODP-LIBS obtains a higher signal intensity and a better depth resolution. A new calibration-based method has been developed to measure the film thickness thinner than the ablation rate [2]. It has been demonstrated that a small fraction (~3.3%) of Re, the main product of neutron-induced transmutation of W, in W is successfully quantified using the calibration-free LIBS method. This will enable us to evaluate neutron damage to W and also to estimate the neutron fluence to W from the fraction of Re in fusion reactors. Development of a LIBS system for in-situ surface analysis during plasma exposure at the PISCES-A linear plasma device is ongoing. Preliminary results will be presented at the conference.

[1] D. Nishijima et al., Spectrochimica Acta Part B 124 (2016) 82.

[2] D. Nishijima et al., Spectrochimica Acta Part B 136 (2017) 34.

Primary author(s) : NISHIJIMA, Daisuke (University of California, San Diego)

Co-author(s) : DOERNER, Russ (University of California, San Diego); HOLLMANN, Eric (University of California, San Diego); BALDWIN, Matt (University of California, San Diego); PATINO, Marlene (University of California, San Diego); UEDA, Yoshio (Osaka University); IBANO, Kenzo (Osaka University); MIYAMOTO, Mitsutaka (Shimane University)

Presenter(s) : NISHIJIMA, Daisuke (University of California, San Diego); DOERNER, Russ (University of California, San Diego); HOLLMANN, Eric (University of California, San Diego); BALDWIN, Matt (University of California, San Diego); PATINO, Marlene (University of California, San Diego); UEDA, Yoshio (Osaka University); IBANO, Kenzo (Osaka University); MIYAMOTO, Mitsutaka (Shimane University)

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