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In situ Raman spectroscopy of silicon surfaces in contact with atmospheric-pressure pressure plasmas DAVID PAI, FREDERIC PAILLOUX, DAVID BABONNEAU, CNRS Institut Pprime, University of Poitiers — We examine the use of in situ Raman spectroscopy for observing changes to surfaces in contact with atmospheric plasmas. As an example, we consider surface plasmas generated in air at atmospheric pressure on alumina thin film-silicon bilayer barriers. We use a nanosecond repetitively pulsed discharge to demonstrate Raman monitoring of the state of the surface, in particular the first order optical phonon of silicon, with a time resolution of 1 s. Depending on the duration of plasma operation, the Raman spectrum of silicon undergoes shifting to lower wavenumber and asymmetric broadening. These changes are consistent with the presence of nanostructured silicon. Ex situ electron micrographs confirm that such structuration occurs at several size scales, down to nanoparticles about 50 nm in diameter. Spectral lineshape analysis showed that these changes are consistent with phonon confinement, laser heating, and/or Fano interference between the scattering from phonons and electronic Raman scattering. We were also able to isolate a systematic change that occurs within the first few seconds of plasma exposure on a previously untreated surface. The Raman peak of Si undergoes a pure enhancement without any shifting or broadening, which is consistent with photon confinement.

David Pai
CNRS Institut Pprime, University of Poitiers

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