NP-07 - **Spontaneous silicon substrate oxidation after FIB milling probed by mid-infrared plasmonic antennas**

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Focused ion beam (FIB) systems are often utilized in the fabrication process of plasmonic antennas. However, the exposure of a substrate to ions can lead to undesirable substrate modifications. This Abstracts / Posters 272 is also the case of silicon substrates which are naturally covered by an ultra-thin (~1 nm) layer of silicon dioxide (SiO_2). When mid-infrared plasmonic antennas are fabricated on Si substrate with native oxide film, the strong absorption peak of SiO_2 at the wavelength of 9.1 µm usually does not affect the optical response of the antennas. Nevertheless, we show that when FIB is used for the fabrication of antennas, the absorption of native oxide gets significant over time and leads to resonant peak splitting. This observation is explained by increased thickness of the SiO_2 film. Arrays of gold mid-infrared antennas (rods with the length of 0.6–2.0 µm) were fabricated on silicon Si(100) substrates (resistivity 6–9 Ω·cm) by gallium liquid metal source FIB (Tescan Lyra3). Fabricated antennas were left exposed to a low or high humidity atmosphere for several days during which the optical response of antenna arrays was studied by Fourier-transform infrared microspectroscopy (Bruker Vertex 80v with Hyperion 3000 IR microscope) for 10 consecutive days. The thickness of the SiO_2 film was determined from X-ray Photoelectron Spectroscopy (XPS) measurements (Kratos Analytical AXIS Supra). Right after the fabrication, the optical response of the antenna arrays shows the linear dependence of antenna resonant wavelength on the length of the antennas and a single resonant peak is present in spectra. The optical response of antennas stored in low humidity atmosphere is stable over time and no significant changes in resonant spectra appeared in 10 days. However, the optical response of antennas stored in high humidity atmosphere evolves with the passing of time and the splitting of the resonant peak into two is clearly visible in the resonant spectra after several days. The splitting is caused by a coupling of localized surface plasmons with phonons in growing SiO_2 film. As SiO_2 film gradually grows in a humid atmosphere, the dip between two “new” resonant peaks becomes deeper.