ACTIVE CONTROL OF OXIDATION OF A SILICON CANTILEVER FOR THE CHARACTERIZATION OF SILICON-BASED SEMICONDUCTORS

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ABSTRACT: Commercially available silicon (Si) cantilever tips are widely used for tip-enhanced Raman spectroscopy [1]. In order to suppress Raman scattering signal of Si-Si phonon mode of the Si tip itself which spectrally overlaps the signals from Si-based semiconductor samples, we thermally oxidized Si cantilever tips at 1100 ºC temperature under H2O steam for several minutes [2]. The surface of the tip was converted to amorphous SiO2. Oxidation reached 250 nm deep from the surface. After 10 min oxidation, the thickness of the SiO2 layer along the tip axis was 1.5 µm as shown in Fig. 1(a). The sharpness of the tip remained the same as before the oxidation process. Raman spectra of the oxidized Si tip and a bare Si tip were measured (Fig. 1(b) and 1(c)). We found that there was no Si-Si phonon mode signal from the oxidized tip. Since the thickness of SiO2 is controllable with the order of nanometer by changing the oxidation time, the plasmon resonance frequency can also be manipulated. The modified tips would be applied to spatial mapping of Raman spectra on Si nano devices.

Fig. 1 A TEM image of (a) the Si tip oxidized by 10 min heating. Raman spectra of (b) the oxidized Si tip and (c) a bare Si tip. In comparison of (b) and (c), the Si-Si phonon mode signal from the tip at 520 cm⁻¹ was completely suppressed from the oxidized tip apex.