Improving the conductivity (<10^{-3} Ωcm) of HfN_x by ion energy control during plasma-assisted ALD

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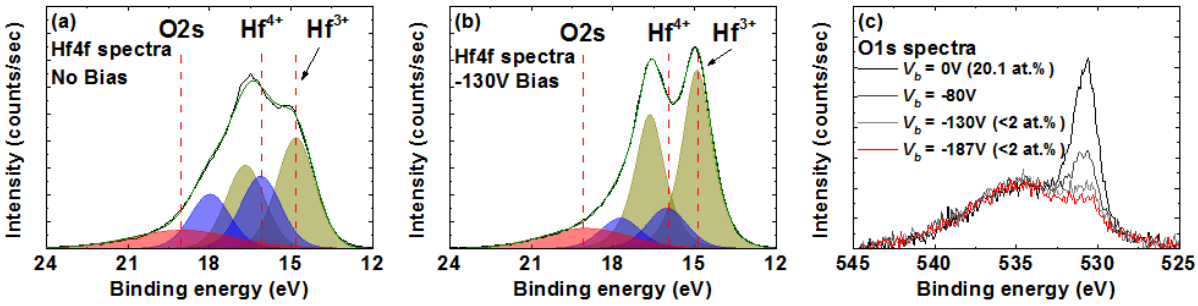

Figure 1: (a, b) Deconvoluted Hf 4f XPS spectra for HfN_x films prepared at T_s = 450°C and at 0V and -130V substrate potential respectively with Hf(III) and Hf(IV) oxidation states (c) O 1s XPS spectra showing a decrease in the Hf-O peak upon increment in the substrate potential from 0 V to -187 V.

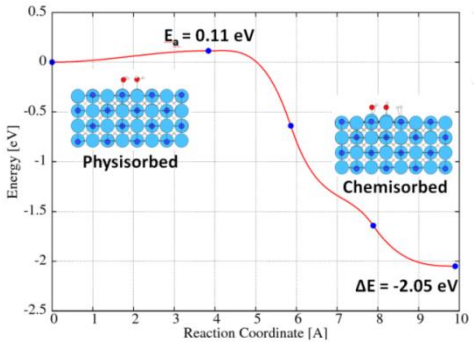

Figure 2: Example of an energy profile computed by DFT: It depicts that H_2O adsorption on HfN surface is kinetically and thermodynamically favoured, given the high reactivity of Hf(III) towards H_2O.

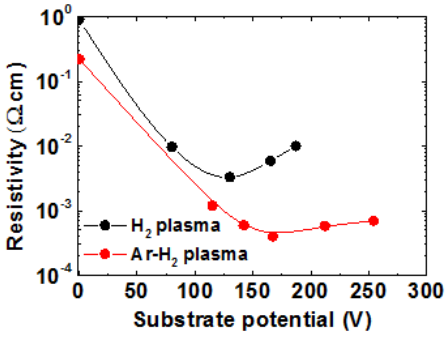

Figure 3: HfN_x resistivity (~70-80 nm) for a film prepared at T_s = 450°C as a function of absolute value of the substrate potential. Results are given for two plasma gas compositions. These results clearly demonstrate the improvement of the film conductivity by ion energy control.