In situ studies of silicon-based thin films growth for crystalline silicon solar cells

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Crystalline silicon solar cell technology currently dominates the photovoltaic market, but several technological as well as fundamental developments are needed to sustain wide–scale implementation of solar electricity. In this seminar, two subjects related to the deposition of silicon–based thin films applied in crystalline silicon solar cells will be discussed.

First, the deposition of amorphous silicon nitride (a–SiN_x:H) antireflection coatings using the expanding thermal plasma source will be discussed. The reactive species emanating from the plasma source operated on an Ar–NH_3–SiH_4 gas mixture were investigated using a combination of several diagnostics, such as Langmuir probe, threshold ionization mass spectrometry and cavity ring–down absorption spectroscopy. Detailed analysis of the observed trends in radical and ion densities versus important plasma parameters revealed the production mechanism of N, NH and NH_2 radicals in the Ar–NH_3–siH_4 plasma and the role of these species in the deposition mechanism of a–SiN_x:H.

The second subject of study was the deposition process of ultrathin amorphous silicon (a–Si:H) films on wafer substrates, which is of eminent importance in recent applications of a–Si:H in crystalline silicon solar cells. Three *in situ* and real time diagnostic techniques probing different properties of the a–Si:H/crystalline silicon system were used: spectroscopic ellipsometry (SE) to monitor the time–evolution of the dielectric function as well as the surface roughness and film thickness, infrared absorption spectroscopy to monitor bound forms of hydrogen in the film and the non–linear optical technique of second–harmonic generation (SHG) to monitor the buried interface and surface properties of the growing film. Combining these three techniques we were able to gain more insight into the growth mechanism and properties of these ultrathin films.