SYEC 4: Photonics-Assisted Green Energy Production II

Time: Tuesday 16:30–17:15 Location: ELP 6: HS 4

SYEC 4.1 Tue 16:30 ELP 6: HS 4

Laser-based diagnostics in nuclear fusion research at Wendelstein 7-X — •Jannik Wagner[1], Golo Fuchert[1], Ekkehard Pasch[1], Jens Knauer[1], Kai Jakob Brunner[1], Marcus Beurskens[1], Sergey A. Bozhenkov[1], Matthias Hirsch[1], Petra Kornejew[1], Maciej Krychowiak[1], Miklos Porkolab[2], Adrian v. Stechow[1], Thomas Wegner[1], Robert C. Wolf[1], and W7-X Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Greifswald, Germany — [2]Plasma Science and Fusion Center, Massachusetts Institute of Technology, Cambridge, MA, USA

Thermonuclear fusion offers the potential of unlimited, carbon-free and safe energy production with little or no long living radioactive waste, compared to nuclear fission. At Wendelstein 7-X (W7-X), one of the world's largest fusion experiments, several laser-based diagnostic methods are employed. Using various wavelengths, they obtain information on plasma parameters, which are important to determine the performance of the W7-X plasma. These diagnostics evaluate for example the light scattered by plasma electrons (Thomson scattering), phase shifts of the laser beam due to plasma density fluctuations (phase contrast imaging), changes in the refractive index (interferometry) or the light emitted by laser-induced electronic transitions in spectroscopic measurements. Lasers are also used for targeted material injection into the plasma edge in order to investigate the transport of impurities (laser blow-off).

In this talk, we will give a short introduction to nuclear fusion and an overview of the laser-based diagnostics at W7-X as an example of diagnostics commonly used in fusion research.

SYEC 4.2 Tue 16:45 ELP 6: HS 4

Making ultra-thin silicon solar cells competitive through hyperuniform disordered light trapping. — •Alexander Lambertz[1,2], Esther Alarcon-Llado[1], and Jorik van de Groep[2] — [1]NWO-i AMOLF, Amsterdam, Netherlands — [2]University of Amsterdam, Amsterdam, Netherlands

Current industrys crystalline silicon solar cells rely on fossil fuels for wafer production and require too much high-quality silicon per watt-peak and are thus unsuitable to meet climate goals. Substantially reducing the absorber thicknesses will not only allow to save silicon, but also to avoid the wasteful Czoralski process, use lower quality poly-silicon, expand the application of c-Si cells to light-weight, semi-transparent, flexible, and wearable photovoltaics.

In order to overcome the shortcoming of poor absorption in thin silicon layers, we present light-trapping patterns based on hyperspectral uniformity to achieve unprecedented absorptance values. We experimentally demonstrated beyond 65% sunlight absorption in one micron thick free-standing silicon membranes and developed an analytical model based on temporal coupled-mode theory to find optimum Fourier-space profiles.

We recently fabricated ultra-thin silicon solar cells of less than five micron thickness by molecular beam epitaxy that have shown over 15 % power conversion efficiencies when our patterns were applied, where flat silicon-nitride-coated references only achieved about 10%. We furthermore give reasonable indication that efficiencies beyond 20 % are achievable already below 10 micron silicon thicknesses.

SYEC 4.3 Tue 17:00 ELP 6: HS 4

Search for ferromagnetism in Mn-doped lead halide perovskites — •Maryam Sajedi[1], Chen Luo[1], Konrad Siemensmeyer[1], Maxim Krivenkov[1], Kai Chen[1,2], James M. Taylor[1,3], Marion A. Flatken[1], Florin Radu[1], and Oliver Rader[1] — [1]Helmholz-Zentrum Berlin für Materialien und Energie — [2]National Synchrotron Radiation Laboratory, university of Science and Technology of China, — [3]Fakultät für Physik, Technische Universität München,

Lead halide perovskites are new key materials in various application areas such as high efficiency photovoltaics, lighting, and photodetectors. Doping with Mn, which is known to enhance the stability, has recently been reported to lead to ferromagnetism below 25 K in methylammonium lead iodide (MAPbI3) mediated by superexchange. Two most recent reports confirm ferromagnetism up to room temperature but mediated by double exchange between Mn2+ and Mn3+ ions. Here we investigate a wide concentration range of MAMnxPb1*xI3 and Mn-doped triple-cation thin films by soft X-ray absorption, X-ray magnetic circular dichroism, and quantum interference device magnetometry. The X-ray absorption lineshape shows clearly an almost pure Mn2+ configuration, confirmed by a sum-rule analysis of the dichroism spectra. A remanent magnetization is not observed down to 2 K. Curie-Weiss fits to the magnetization yield negative Curie temperatures. All data show consistently that significant double exchange and ferromagnetism do not occur. Our results show that Mn is not suitable for creating ferromagnetism in lead halide perovskites.