SCALING SELECTIVE AREA EPITAXY OF THE EARTH-ABUNDANT PHOTOVOLTAIC MATERIAL Zn3P2

Aidas Urbonavicius[1,2], Sebastian Lehmann[1,3], Kimberly A. Dick Thelander[1,2,3], Simon Escobar Steinvall[1,2]
[1] NanoLund, [2] Centre for Analysis and Synthesis, [3] Division of Solid State Physics

Growth scalability of defect-free Zn3P2, a semiconductor which has been shown to be suitable for thin film photovoltaic applications, is an important step for moving away from scarce materials in thin film solar cells. The biggest obstacle in scaling Zn3P2 growth is that it tends to grow with many defects, which result in poor crystal quality that is detrimental for photovoltaic applications. [1][2]

Selected Area Epitaxy (SAE) has been utilized for developing a new method for producing high quality Zn3P2 thin films. It has been shown to work by using molecular beam epitaxy (MBE) together with silicon oxide mask on indium phosphide substrates.[3] Because indium is a rare material and use of MBE and electron beam lithography (EBL) have low throughputs, it makes scalability challenging.

To achieve scalability of Zn3P2, we are currently developing a method using SAE combined with metalorganic vapor phase epitaxy for growing Zn3P2 thin films. We have determined that by adjusting precursor flows and temperature, it is possible to minimize unwanted effects such as parasitic growth and improve growth selectivity, which could lead to growth of high quality Zn3P2 thin films.

We have conducted preliminary research on InP substrates, which is not ideal, thus we will focus our future research on Si based substrates. To scale SAE Zn3P2 thin film growth, we will use Talbot Displacement Lithography, an optical lithography technique with sub-wavelength feature sizes, instead of EBL to allow for exposure of larger areas at optical lithography throughput levels.