Institute for Microelectronics and Microsystems
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Silicon nanostructures for solar energy harvesting

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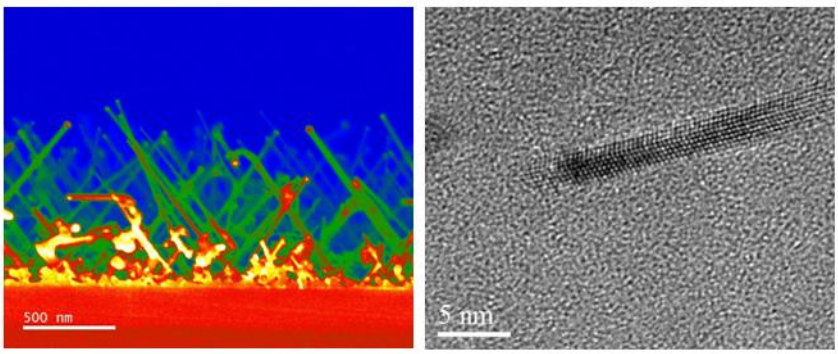
Abundance, stability and non-toxicity are the silicon properties which have undoubtedly made it one of the leading actors in the solar cells market during the last decades. The roadmap however demands a product cost cut and an efficiency increment for this to hold in the next years. Silicon nanowires have been proposed as the cell emitter active layer thanks to their optical properties, like the light trapping enhancement and the quantum confinement effects, expected when their mean diameter is less than the free exciton size (5 nm) in the bulk silicon [JAP 113, 214313 (2013), "Nanowires - New Insights, INTECH, Review Chapter (7), 131-153 (2017), SolMat 132, pp. 118-122 (2014)]. When their diameter is reduced down to 3.5 nm, the plasmon behaviour changes, due to suspected increment in the spatial dispersion or surface scattering, exhibiting an increase in both the bulk and surface signals. But the literature on this regard is still preliminary and in some cases contradictory. The synthesis and the characterization of such small silicon nanostructures is not trivial, when control and knowledge on the morphological, structural and surface chemical properties is demanded [Scientific Reports, Vol. 9, 5647 (2019), Nanomaterials, 9(6), 818 (2019), ACS Omega doi: 10.1021/acsomega.9b01488 (2019)]. The seminar will discuss the most common methods to fabricate these types of nanostructures focusing on chemical vapor deposition, one of the most controlled methods in terms of synthesis parameters and final morphological results. It will also discuss the issues related to their synthesis when the goal of obtaining sizes below 5 nm is targeted. Morphological and chemical property studies, using HAADF TEM analysis and other advanced characterization techniques, will be reviewed, focusing on the plasmon loss behaviour of these nanostructures when analysed under high energy resolution conditions.



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