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Plasma ALD strategies for area selective deposition

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The scaling of transistor is still on the road only thanks to the introduction of complex multiple patterning steps that are more and more expensive and time consuming. Therefore, microelectronic industry needs new solutions and integration schemes, one of them being the development of a new bottom-up approach called Area Selective Deposition (ASD) [1]. Atomic Layer Deposition (ALD) is a viable tool for nanoscale ASD by using different strategies: inherent selectivity of the precursor, surface activation, surface deactivation, and super-cycles [2]. In our lab, we developed plasma-based area selective deposition processes by merging two plasma processes in a unique ALD tool: PEALD process and Plasma etching process. In this way, super-cycles are created with alternate deposition and etching steps [3-5]. Right now, we have developed ASD processes with many different plasma-etching steps: radical only plasma etching steps, reactive ion etching steps, atomic layer etching (ALE) steps, physical only etching steps. Ions from the plasma are also used during the ALD step to spatially modify the material (density, crystallinity...) on 3D structures for a Topographically Selective Deposition (TSD) [6]. This presentation will outline and provide several examples of all the different scenarios developed and obtained the last years in our group as well as state of the art of other groups in the world. [1] R. Clark et al, APL Mater. 6, 058203 (2018) [2] A.J.M. Mackus et al, Chem. Mater. 31, 2 (2019) [3] R. Vallat et al, J. Vac. Sci. Technol. A 35, 01B104 (2017) [4] R. Vallat et al, J. Vac. Sci Technol. A 37, 020918 (2019) [4] A. Chaker et al, Appl. Phys. Lett. 114, 043101 (2019) [5] C. Vallée et al, J. Vac. Sci Technol. A 38, 033007 (2020) All the following researchers have collaborated to this work. From LTM: M. Bonvalot, T. Yeghoyan, R. Vallat, A. Chaker, V. Pesce, M. Jaffal, S. Belahcen, O. Salicio, B. Pelissier, G. Lefèvre and A. Bsiesy. From CEA/LETI: R. Gassiloud and N. Possémé.