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Etching for New Devices[1]

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Information network and services are now one of the most important social infrastructure. They have been growing by progression of LSI devices. An important characteristic of the LSI device is function extendibility by integrating new materials and new device concepts. Plasma processes are key fabrication technologies of the LSI devices, and have been confronted to meet various requirements. Two topics will be presented here. First topic is Silicon Photonics (SiPh) which is a newly-proposed device for data communications. It has come to reality by applying the CMOS process technology on optical devices. However, there are points to be modified. One is nanometer-order control of line-edge-roughness at a very wide Si waveguide patterning. An ArF immersion lithography and a gate etching technique for 55 nm technology node and after were applied to fabricate a 440-nm-wide Si waveguide [1]. Low optical propagation loss of 0.5 dB/cm was achieved. The other is a light source integration on the SiPh device. A MEMS deep etching process was applied to fabricate a pedestal to mount a laser diode chip [2]. Second topic is magnetic material integration to realize MRAM. We need to deposit a multilayered transition metal/oxide stack film by PVD, and fabricate magnetic dot array with a few tens of nanometers in diameter without deteriorating magnetic properties. However, chemical modifications of the materials are indispensable to proceed reactive ion etching. To overcome this issue, a recovery process by reductive chemistry was proposed as an after treatment of the methanol plasma etching, and obtained comparable performances with an Ar ion etched non-damage sample [3]. [1] S.-H. Jeong, et al., Opt. Express, 21, 30163 (2013). [2] K. Kinoshita, et al., AVS 63rd Symp., PS-ThP18, (2016). [3] K. Kinoshita, et al., Jpn. J. Appl. Phys., 51, 08HA01 (2012).

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