Micromachining of FM/M/FM films using an active Q-switched Nd:YAG laser

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The micro thin-film inductor is composed of a number of thin-film layers such as insulation layer, planar coil layer, and magnetic layer. These thin-film layers are generally coated on the silicon(Si) substrate by using the sputtering method which gives high adhesive strength [1]. The most common patterning method of the micro-inductor is successive applications of lithography, etching, and cleaning process which also consist of the basic processes of the semiconductor fabrication[2]. In case of multi-layer inductor like FM(ferromagnetic)/M(Metal)/FM(ferromagnetic), the patterning processes should be carried out in each layer, which can be said quite complicated and elaborate. In this work, we have optimized the operation conditions of the laser for the patterning in the FM/M/FM multi-layer, which can be readily used for the fabrication of the micro thin-film inductor. A diode-pumped Nd:YAG laser was actively Q-switched in order to obtain a high power short pulse laser beam whose spatial mode was TEM_{00} mode. The measured pulse width was about 200 ns, its peak power was 25 kW, and the used pulse repetition rate was set to be 5 kHz. The optimal energy of a laser pulse was found to be 5 mJ and the focused beam with diameter of 5~10 μm was launched to the FM/M/FM multi-layer. Due to the high intensity of the laser beam, the major interaction between laser beam and the material is vaporization rather than melting. The pattern formed by this vaporization process was very clear and had a line width as narrow as 20 μm(Fig. 1).

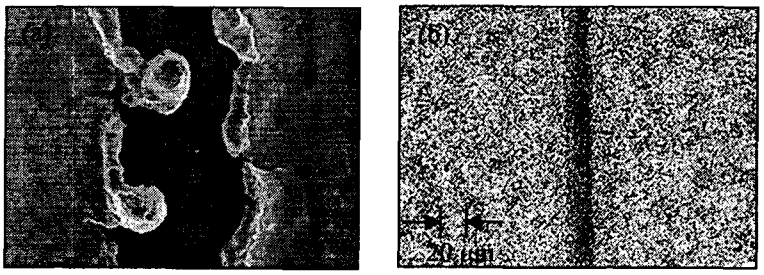

Fig. 1 Scanning electron micrographs of the line patterning in FM/M/FM thin-film using the CW Nd:YAG laser (a) and active Q-switched Nd:YAG laser (b).

References

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