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Magnetic transition of a nickel target during sputtering process in Ar or Ar/O2 mixtures

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It is well known that the sputtering of a magnetic target in magnetron sputter deposition processes is not an easy task. The magnetic field being perturbed by the target, the sputtering efficiency is widely reduced as compared to a non-magnetic element. A way to overcome this limitation could be to allow the target temperature to increase up to the Curie temperature (Tc). At this step the magnetic material would lose its properties. The magnetic field would not be decrease anymore leading to a more efficient sputtering process.
We have investigated this magnetic transition on a Ni target by thermally disconnecting the target from the cooled magnetron cathode. Nickel was chosen as a case study because Tc is quite low (358°C). To evidence the transition, measurements were carried out with a magnetic sensor placed in front of the target. The change in the sputtering regime was investigated by means of an energy flux diagnostic based on a thermopile sensor [1]. The relevance of such measurements have been proved in a previous work [2], where a sharp increase of the energy transferred to the substrate has been evidenced when Tc is reached. From the IR radiation emitted from the hot target, the true surface temperature can be evaluated. In this contribution the sputtering of a Ni target in a reactive atmosphere will also be presented. Complementary measurements will be carried out by energy-resolved mass spectrometry in order to evidence the species produced by the target sputtering or created in the plasma, which finally interact with the substrate. This will be investigated depending on the percentage of reactive gas in the atmosphere that means along the well-known hysteresis curve, for both a cold and a hot target. The effect of a possible un-suspected heating of the target surface on the reactive magnetron sputtering regime would thus be able to be evidenced.
[1] P.-A. Cormier et al, J. Phys. D: Appl. Phys. 43 (2010) 465201
[2] A. Caillard et al, IEE Transactions on Plasma Science 42(10) 2802

Keywords
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