

Growth simulation of hard coatings

Hard coatings are usually deposited on cutting tools to protect them during machining. The resistance against wear and degradation is highly important for the quality of the cut and the life of the tools. A wide number of films have been tested in previous studies, from experimental and theoretical ones. The composition of these films is based on binary or ternary metal nitride and carbide. The physical properties like density, crystallography, microstructure, adhesion, hardness etc. were investigated by classical laboratory equipments and also tested on production.

During the last years, simulation tools were developed concerning the growth of the films. Because of the large numbers of parameters, software were most dedicated to "GLAD" films [1], which present a particular structure and could easily be compared. But growth simulation still presents an interest for other films for the prediction potential they give. And all the information found by the past studies could be use in this way. The first work in this PhD, is to collect all the data of the sputtered species impinging the substrate and the film and all the data of energy in the film between the atoms. All these data will be implemented in the software developed by a partenary laboratory (FEMTO-ST) [2]. In parallel, the second work is to elaborate simple thin films in order to reduce the parameters. Characterization of the phenomena's occurring during the deposition (Energy, momentum and direction of species) and the physical properties of the films will be realized. Finally, the simulation results as the experimental one will be compared (microstructure, stress). This process will be done all the time necessary to obtain a good correlation.

After, this first work, more complex films like hard coatings could be tested. Is this way the student should not forget the final application, and will work on the required physical properties of hard coatings dedicated to metal and wood machining and submitted to special working conditions. The performance of the films could be tested on production.

Key words: growth simulation, sputtering, hard coatings, characterization.

Required degrees: the student should have a master degree. Knowledge in physics, physics of vacuum deposition and in thin films characterization is required. Some initiation in informatics will be appreciated.

References:

[1] K. Robbie and M.J. Brett, J. Vac. Sci. Technol. A13 (1995) 1460.

[2] Besnard A., Martin N., Carpentier L., IOP Conf. Ser.: Mater. Sci. Eng., vol. 12, n° 1 (2010) 012011-4

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