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DocMASE

Education and Culture
Erasmus Mundus

DocMASE Project Proposal 2014-03

Project Title	**High temperature mechanical properties of magnetron sputtered thin ceramic films**
Main University and Advisor	Linköping University (Sweden) Prof. Magnus Odén
Second University and Advisor	University of Lorraine (France) Prof. Jean-François Pierson
Associated Partner(s) (if applicable)	SECO Tools AB Dr Mats Jöesaar
Project Description (with **image**, if applicable)	Thin hard films are often used as wear protection on parts that are subjected to sever working conditions such as tools for metal machining. Typically a ceramic alloy of transition metal nitride, oxide or carbide is used, for example TiAlN. When used for commercial purposes these films are grown in large scale facilities and under industrial environmental conditions, which results in a polycrystalline material with an impurity level of about 1%. In this project we want to grow single crystal model materials with a very low level of impurities in order to isolate and study the different deformation mechanisms active in these materials at elevated temperature. This will be achieved though film growth by reactive magnetron sputtering and testing of the films by high temperature nanoindentation. In addition, the same material compositions but with a polycrystalline microstructure will be grown on WC/Co substrates by cathodic arc evaporation in an industrial setting and these samples will be analyzed with the same techniques to ensure validity of study for cutting tool applications. At Linköping University you will synthesis the films in a new deposition chamber and characterize them by x-ray diffraction and TEM. You will also use a newly installed high-temperature nanoindentor to extract elastic and plastic properties of the films. At Université de Lorraine you will learn to use a state-of-the-art STEM to characterize the films at an atomic scale. You should apply to this project if you have a background in Material Science or Material Physics and a large interest in doing advanced experimental work. You must enjoy thermodynamics and dislocation theory if this project should suit you. You will be part of a large research team comprising both theoreticians and experimentalists with whom you will be collaborating. You will also actively be collaborating with industrial partners who will be very interested in your work.
Previous Publications	M.P. Johansson Jöesaar, N. Norrby, J. Ullbrand, M'Saoubi, and M. Odén: Anisotropy effects on microstructure and properties in decomposed arc evaporated $Ti_{1-x}Al_xN$ coatings during metal cutting, *Surf. Coat. Technol.* **235** 181-185 2013. N. Ghafoor, L.J.S Johnson, D.O. Klenov, J. Demeulemeester, P. Desjardins, I. Petrov, L. Hultman, and M. Odén: Nanolabyrinthine ZrAlN thin films by self-organization of interwoven single-crystal cubic and hexagonal phases, *APL Mater.* **1** 022105 2013.
Requirements of the candidates / Requirements during the doctoral programme (courses, seminars, etc.)	At least a Bachelor in Material Science of Material Physics, but preferably also a Master on same field. In order to graduate from the program the student must fulfil all requirements for a PhD at both Linköping University and Université de Lorraine. One example of such requirements is to take 90 ECTS course credits. You should go to international conferences and present your work and publish your findings in international peer-reviewed archive journals.