DocMASE Project Proposal 2013-03

Project Title	High energy x-ray characterization of wear resistant coatings
Main University and Advisor	Linköping University (Sweden) / Prof. Magnus Odén and Dr Lina Rogström
Second University and Advisor	Technical University of Catalonia (Spain) / Prof. Marc J Anglada
Associated Partner(s) (if applicable)	SECO Tools AB / Dr Mats Johansson
Project Description (with **image**, if applicable)	Transition metal nitride coatings are widely used in wear resistant applications. Many of these coatings are metastable and undergo phase transformations when exposed to high temperatures which can be favourable for the mechanical properties of the coating. To understand and predict the high temperature behaviour of the coatings, a combination of experimental and theoretical work is needed. This project will focus on the experimental part to improve the knowledge of the as grown and heat treated coatings which will further act as support for the theoretical work. This project will involve growth of coatings by magnetron sputtering and cathodic arc evaporation techniques as well as advanced characterization of the coatings. The characterization will focus on the use of high energy x-ray scattering techniques at synchrotron light sources to study the structure of as grown coatings as well as of coatings exposed to high temperatures. In-situ x-ray scattering during growth will also be performed to follow the structure evolution during growth. Diffuse x-ray scattering will be used to probe possible clustering on sub-nm scale of similar metal species in the as grown coatings. In-situ small and wide-angle x-ray scattering during annealing will be used to follow the microstructure evolution during phase transformation/separation. The results will be important input parameter in modelling of the coating behaviour at high temperature.
Previous Publications	L. Rogström *et al:* "Strain evolution during spinodal decomposition of TiAlN thin films," Thin Solid Films 520, 5542-5549 (2012). F. Tasnádi *et al:* "Significant elastic anisotropy in Ti1-xAlxN alloys," Appl. Phys. Lett. 97, 231902 (2010).
References	B. Alling *et al:* "Unified cluster expansion method applied to the configurational thermodynamics of cubic Ti_{1-x}Al_{x}N," Phys. Rev. B 83 (10), 104203 (2011).
Requirements of the candidates / Requirements during the doctoral programme (courses, seminars, etc.)	The student should have a solid background in Material Science or Material physics with an outstanding academic record. The student selected for this project will work with advanced materials, using state-of-the-art equipment, in one of the world's most prominent lab for coatings and thin films. PhD duration should be 4 years, the actual duration depends on achievements. 90 ECTS course credits must be completed before graduation among which a maximum of 30 ECTS can be accounted for by courses taken during the Master studies on advanced level if the supervisor approves their relevance. The remaining ECTS course credits must be completed through additional course work.