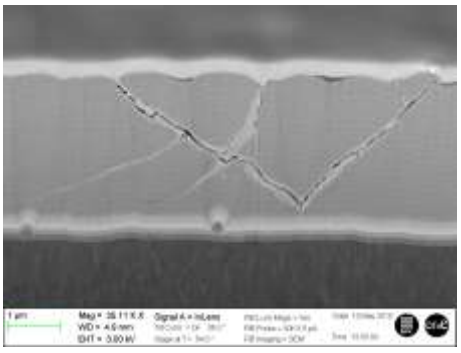
Project Proposal for 2011 DocMASE Candidates

Project Title	***Micromechanical design of coatings for forming tool-like applications***
Main University and Advisor	**Universitat Politècnica de Catalunya (UPC)** (Barcelona, SPAIN) Dr. Luis LLANES (luis.miguel.llanes@upc.edu)
Second Univ. and Advisor	**Linköping University (LiU)** (Linköping, SWEDEN) Dr. Naureen GHAFOOR
Associated Partner(s)	**SECO Tools** Dr. Mats JOHANSSON
Project Description	The quest for improving the performance of tools and parts demands key surface technologies for achieving of a superior tribomechanical resistance. From this viewpoint, although hard coatings are frequently used to enhance the lifetime of cutting tools, application of similar surface engineering approaches on forming tools and machine components are still relatively scarce [1]. Considering that these applications often imply complicated service conditions, ***it is the purpose of this study to set out and implement contact loading protocols, as a new testing methodology, for assessing the performance of the coated system from a toughness-fatigue-galling (forming tool-like) perspective.*** Although knowledge on the behavior of hard coated systems under repetitive contact loading is rather scarce, it is clear that repetitive impacts imply a mechanical degradation of the system (see Fig. 1.), which has been correlated to an evolution of surface damage in terms of substrate plastic deformation, followed by cracking of the coating and final interface failure. Hence, it is aimed to ***conduct systematic studies of the contact response and damage mechanisms induced by spherical indentation, under monotonic and cyclic loading, on reference and advanced/innovative coated systems*** (e.g. low friction, ultrahard nanocomposites and/or multilayered films). In doing so, particular attention will be paid to the identification of critical damage phenomena, evaluation of the mechanical fatigue sensitivity of the coated system, and assessment of the tribochemical response as related to friction, wear and fretting fatigue. The detailed characterization will be conducted at both micro- and nanoscales through use of suitable techniques such as nanoindentation, microscratch, AFM, FIB, electron microscopy and spherical indentation by means of universal testing systems.  Fig. 1. SEM image (cross-section) showing damage features induced on a multilayer film under contact loading.
References	[1] S. Hogmark, S. Jacobson and M. Larsson, Wear 246 (2000) 20.
Previous Publications	1. L. Llanes, E. Tarrés, G. Ramírez, C.A. Botero and E. Jiménez-Piqué, *Procedia Engineering* 2 (2010) 299 2. G. Ramírez, E. Tarrés, B. Casas, I. Valls, R. Martínez and L. Llanes, *Plasma Processes & Polymer*, 6 (2009) S588 3. E. Tarrés, G. Ramírez, Y. Gaillard, E. Jiménez-Piqué and L. Llanes, *Int. J. Ref. Metals & Hard Mater.* 27 (2009) 323 4. B. Casas, U. Wiklund, S. Hogmark and L. Llanes, *Wear*, 265 (2008) 490 5. B. Casas, M. Anglada, V.K. Sarin and L. Llanes, *J. Mater. Sci.*, 41 (2006) 5213