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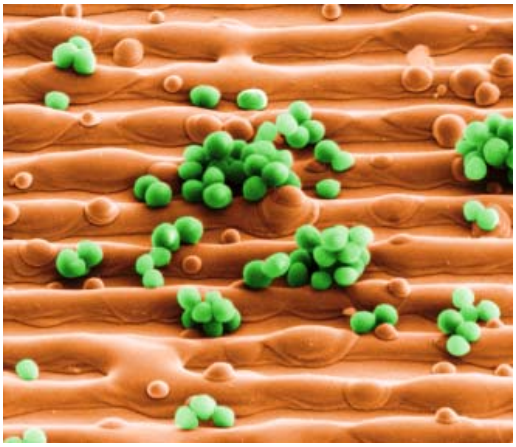
Doc MASE

Education and Culture
Erasmus Mundus

DocMASE Project Proposal 2015-01

Project Title	**Characterization and design of oxide layers on copper alloys for antimicrobial purposes**
Main University and Advisor	Saarland University (Germany) Prof. Frank Mücklich
Second University and Advisor	University of Lorraine (France) Ass. Prof. David Horwat
Associated Partner(s) (if applicable)	
Project Description (with **image**, if applicable)	The antimicrobial effect of copper and its alloys is well known, although the specific toxicity mechanisms and their relation to material and surface properties still remains unclear [1]. Numerous field studies have proven the potential of copper alloys to reduce the nosocomial infection rate in hospitals. Recent studies suggest that the formation of Cu_2O or CuO plays a major and also different role in the killing process of bacteria [2]. Cu_2O is one of the main oxidation products on copper alloys in repeated contact with skin under atmospheric conditions [3]. To understand the governing material properties for a long term effective, antimicrobial copper alloy, it is thus mandatory to investigate, how other oxides formed on these alloys (e.g. zinc, tin, alumina oxides) interact, influence or even passivate antimicrobial copper oxides.  The proposed project can be divided into the following segments: - Characterization of oxide layers on "contact killing" copper alloys in use by metallurgical means and SEM, FIB and EDX techniques (*UdS*) - Generation and characterization of pure and well defined model surfaces consisting of Cu, Zn, Sn, Al and their oxides via reactive sputtering processes (*UL*) - Correlation of model- and real oxide layer structures to copper ion release and actual antimicrobial efficiency (wet plating assays with bacteria, UdS) - Based and depending on the findings: proposition and/or design of a long term efficient and stable copper alloy (surface) optimized for antimicrobial use in atmospheric environment. (*UdS*)
Previous Publications	Mathews, S.; Hans, M.; Mücklich, F.; Solioz, M. Contact Killing of Bacteria on Copper Is Suppressed If Bacterial-Metal Contact Is Prevented and Is Induced on Iron by Copper Ions. *Appl. Environ. Microbiol.* **2013**, *79*, 2605–11 [3] Hans, M.; Erbe, A.; Mathews, S.; Chen, Y.; Solioz, M.; Mücklich, F. Role of Copper Oxides in Contact Killing of Bacteria. *Langmuir* **29** (2013) 16160-16166.
References	[1] Grass, G.; Rensing, C.; Solioz, M. Metallic Copper as an Antimicrobial Surface. *Appl. Environ. Microbiol.* **2011**, *77*, 1541–7 [2] Fredj, N.; Kolar, J. S.; Prichard, D. M.; Burleigh, T. D. Study of Relative Color Stability and Corrosion Resistance of Commercial Copper Alloys Exposed to Hand Contact and Synthetic Hand Sweat. *Corrosion Sci.* **2013**, *76*, 415–423
Requirements of the candidates / Requirements during the doctoral programme (courses, seminars, etc.)	• Very good level of English • Good knowledge of German is preferred • Responsible design and conduction of experiments • Dedicated and independent working attitude • Master in Materials Science (or closely related disciplines) • Knowledge of/experiences with Microbiology are preferred. • 30 ECTS must been acquired during the program according to the minimum requirements of DocMASE.