



## Processing and Characterization of Advanced Composites for Resource-Efficient Applications and Technologies

*“CREATE-Network”*

### Report: Deliverable D2.1 - FIB/SEM tomography of cracks

Deliverable No	Deliverable Name	WP No	Start Month	End Month	Lead Participant Short Name	Nature	Dissemination Level	Delivery Month
D2.1	FIB/SEM tomography of cracks	2	1	32	USAAR	Report	PU	24

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The FIB/SEM tomography was applied to the characterization of comb cracks in inserts. During this work different parameters like the size of the tomography, resolution, distance between slices, electron and ion current were optimized in order to achieve the best image quality. Then the serial sections were worked out in a proper software in order to make the 3D reconstruction of the cracks, as it is shown in the Figure 1.

This work was presented at the 20th Symposium of Composites in Vienna, Austria the 1-3 July 2015. Moreover, it was published in Materials Science Forum as:

J. García, T. Carvalho Miranda, Haroldo C. Pinto, F. Soldera, and F. Mücklich, 3D-FIB characterization of wear in WC-Co coated composites, *Materials Science Forum Vols. 825-826 (2015) 995-1000*.  
doi:10.4028/www.scientific.net/MSF.825-826.995.

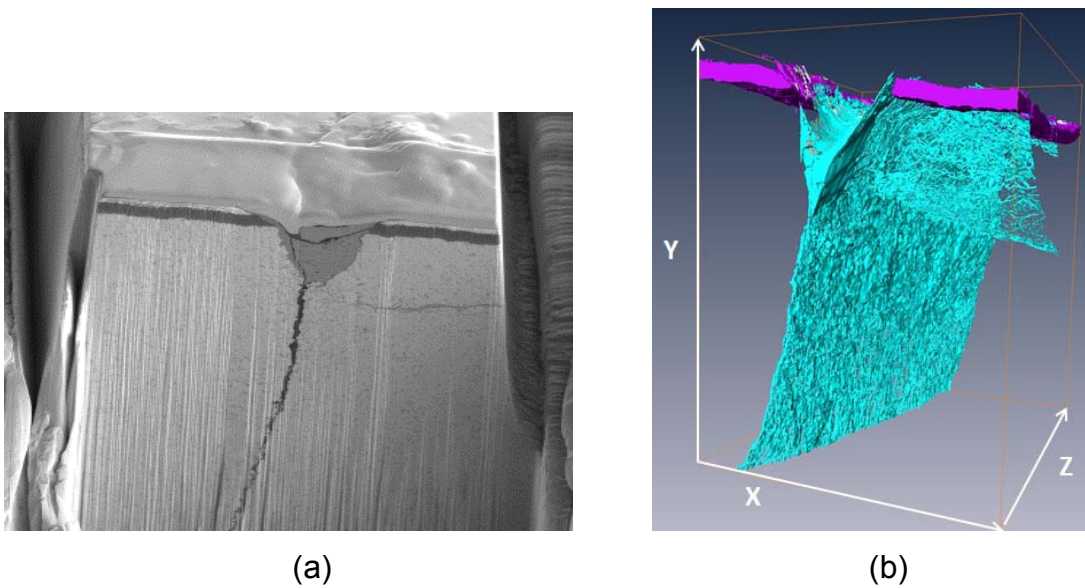


Figure 1: a) SEM image used for the reconstruction, showing the microstructure changes at the different places of the region of interest. b) 3D visualization of the comb crack investigated. The crack is marked with Cyan and the coating is marked with Lila.

Further work with SEM/FIB Tomography was performed on Carbon-Nickel composites (Ni/CNTs, Ni/nD, Ni/OLC), as it is shown in the Figure 2.

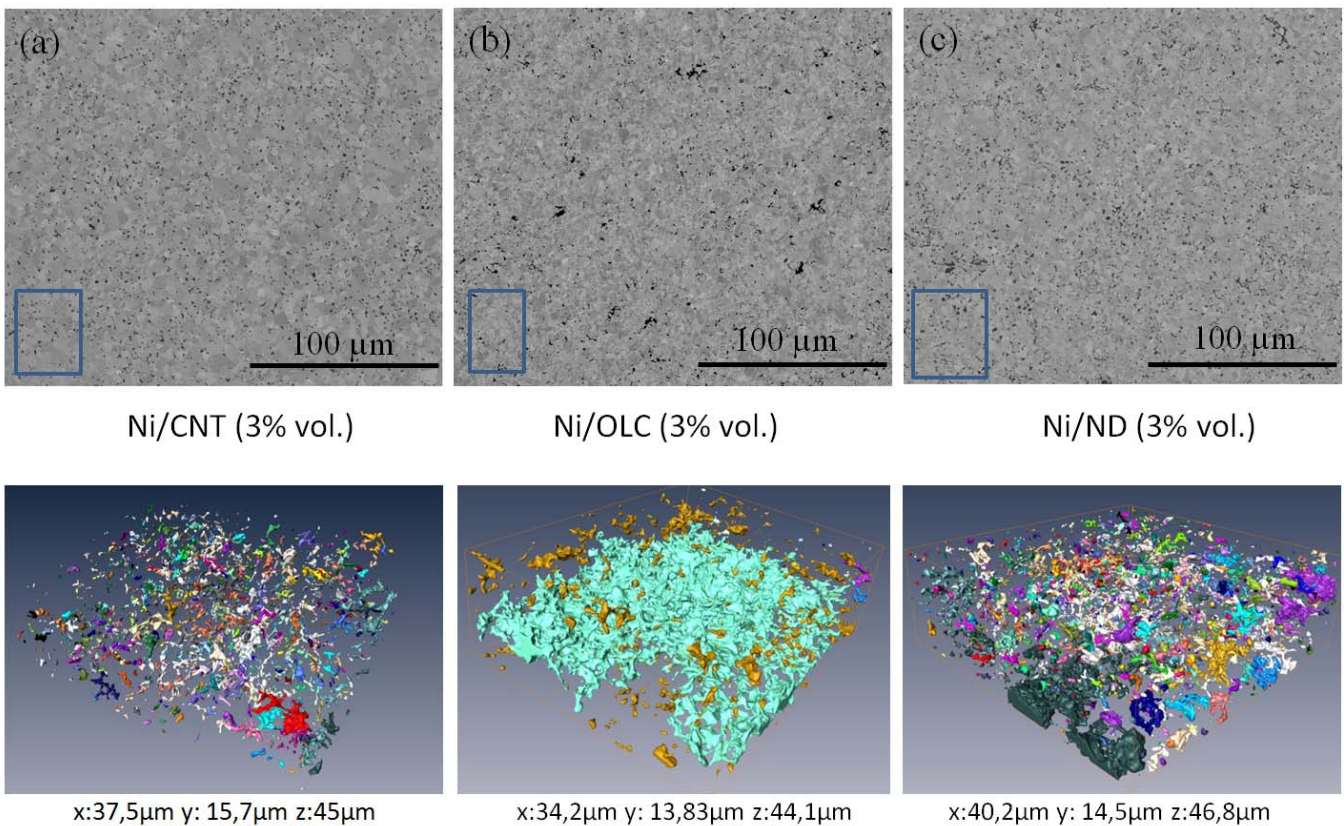


Figure 2: a), b), c) SEM images of Ni based composites. d), e), f) corresponding 3D reconstruction after SEM/FIB tomography. The blue squares represent the size of the zone of interest.



These results were presented in the "Congreso Internacional de Metalurgia y Materiales - 16° SAM-CONAMET" in Cordoba, Argentina the 22nd - 25th November 2016. The contribution was entitled "Expanding the uses of the Focused Ion Beam technique: 3D-analysis of morphology and crystallography of micro and nanostructures" by Flavio Soldera, Sebastian Suárez, Leander Reinert and Frank Mücklich. (<http://sam-conamet2016.congresos.unc.edu.ar/>)

The results presented in this deliverable are part of the WP2, which deals with the development of new methodologies necessary for the characterization and analysis of specific materials conditions in this project. The reconstruction of the cracks will allow to better understanding of the damage of coatings and substrates during the lab-tests as well as service life of the cutting tools (WP3, WP4). This new knowledge will help for the design of optimized coating/substrate systems (WP1) in a feedback mechanism.

The results obtained from the 3D data analysis of Ni-CNT composites allows to understand and optimize the material processing (WP1), and will be used for modeling the tribological and conductive properties of the composites (WP3).

In a further deliverable of the WP2 it is expected to combine different characterization techniques towards correlative microscopy. The FIB/SEM Tomography and consequently 3D-Analysis provides an overview of the composites and coatings, however the next steps are related to high resolution methods.



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