Topic 1

AFM applied to microstructural study of metallic materials

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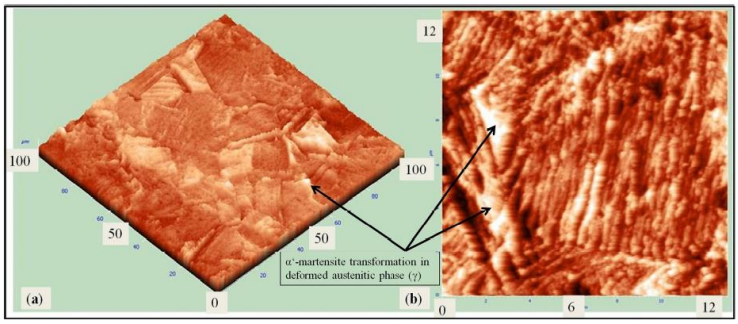
*with the collaboration of CNR-IPCB

AFM, atomic force microscopy, is an investigation method widely used in Material Science, due to the plethora of information that can be derived from it. The most apparent information, is the topography of the investigated surface down to nanometric scale, hence this technique has been primarily devoted to investigations on thin films and nanomaterials, but other characteristics can be derived through the interaction of the scanning tip of AFM with the beneath material. Moreover, the quality and type of data obtained is strictly related with capabilities of different instruments, and the measurement settings.
The object of the proposed work is to evaluate which information can be obtained about the microstructure and properties of metallic material, in addition to surface topography. After a first explorative campaign, on different alloys (shape memory alloys, aluminum alloys), the attention will be focused on a specific metallic material on which deeper investigations will be performed and optimized. Additional analysis with other techniques (scanning electron microscopy, EDX analyses, EBSD analyses) will be also performed in order to complement AFM data. Thanks to the obtained results, new competences in the characterization of metallic materials and correlative microscopy will be achieved. This expertise could be applied to metals of high strategic and commercial importance, for instance corrosion resistant alloys, additively manufactured components, smart metallic materials.



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Topic 2

New metallic materials produced by combustion reactions

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The thermite (or thermit) reaction was discovered in 1893 by German chemist Hans Goldschmidt, after whom the reaction is sometimes called the "Goldschmidt reaction" or "Goldschmidt process". In this process, a mixture of metal and oxide is ignited by heat or chemical reaction, and then thermite mixture undergoes an exothermic reduction-oxidation (redox) reaction, obtaining as final results the melting of the involved metals. This effect has been applied in welding process, since very early times: the first commercial application of thermite was the welding of tram tracks in Essen, Germany, in 1899.
The object of the proposed work is to try to recycle waste and scraps from metalworking, with a thermite-alike process in order to obtain usable materials. Candidate materials from industrial processes will be characterized and tested in small scale reaction trials, and according to the obtained results and reaction products, modifications and/or addition of other materials will be evaluated. A final characterization of the more promising product will also be performed to evaluate its possible final applications.


(Picture from Wikipedia, “Thermite reaction”)