NANOINDENTATION: A POWERFUL TOOL TO EXPLORE THE WIDE CHEMICAL SPACE OF HIGH ENTROPY ALLOYS

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High entropy alloys (HEA) are multi-component alloys, without any minor or major elements (i.e. : all elements are very concentrated) and they form a unique solid solution. It was proven that, especially for the system Co-Cr-Fe-Mn-Ni, they exist for a very wide range of composition [1]. This opens the opportunity of multi-properties optimization, like cost, density and mechanical resistance. However, to take advantage of this opportunity, accelerated mechanical testing tools are required.

In this perspective, a simplified processing route and a specific nanoindentation procedure were defined (see *Figure 1*). It permits to test experimentally 25 different HEA compositions within the Co-Cr-Fe-Mn-Ni system [2]. Tensile tests were also performed on selected compositions and were deeply compared to hardness results in order to establish a confident correlation between hardness and yield strength [3]. Based on these experimental results, it was established that (i) the solid solution strengthening (SSS) can be significantly increased by varying the composition, and that (ii) the SSS doesn't evolve linearly with composition. To go further, these experimental results were compared to a fully analytic and parameter-free model which predicts the solid solution strengthening and then the yield strength of HEA [4, 5]. The comparison between the experimental hardness and the simulated yield strength provide guidelines to appropriately choose the entry data which are needed for the model. Finally, perspectives will be drawn on HEA properties optimization.

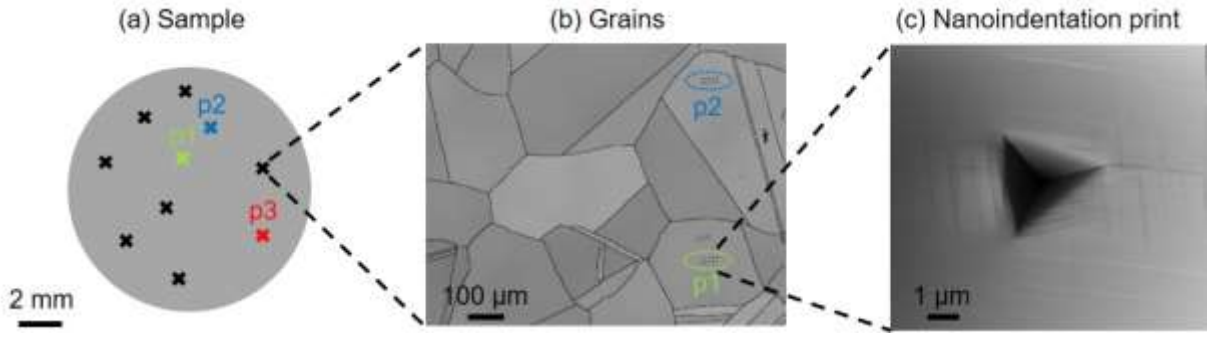

Figure 1: The nanoindentation procedure to study solid-solution strengthening of high entropy alloys.

References

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