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Structural Characterization of High Entropy Alloy (FeCoCrNiMn) Synthesized by Mechanical Alloying

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High entropy alloys (HEAs) which usually contain five or more elements with equal or near equal atomic ratio, was proposed recently at the start of this century [1-2]. Yeh defined HEAs as alloys of more than 5 main components with concentrations of 5 to 35 atomic % [3]. It opens up the possibility of creating new metallic alloys with good mechanical properties, especially at elevated temperature. In these alloys, the entropy term may dominate over enthalpy, preventing the occurrence of chemical ordering [3,4]. Mechanical alloying (MA) process is described by the repeated welding and fracturing of powder particles entrapped between milling media, extent of which depends on the mechanical attributes of powder constituents [5]. In 1981 Brian Cantor together with his student found that an alloy with a composition of 20 atomic% (CoCrFeMnNi) solidified in a single FCC phase, for this reason, this alloy is known as "Cantor's alloy" [6]. They generally present a single FCC or BCC phase, although they can also present a combination of these two phases, due to their intrinsic characteristics such as the effect of high entropy and the disordered occupation of the atom [7].

In this work, the FeCoCrNiMn-HEA was synthesized during 100 h by mechanical alloying (MA). The pure elements were alloyed in a planetary mill, at 300 rpm with a ball / powder ratio of 10: 1 and a ball / ball ratio of 1: 1. The alloyed powders were sintered in a high temperature tube furnace at 1100°C for 2 h. The microstructural characterization of HEA bulk was carried out by X-ray diffraction to identify the phases formed after sintering. Also, the bulk was analized by Optical microscopy (OM) and scaning electron microscopy (SEM) to determine the morfology and chemical composition of the phases formed.

Figure 1a) shows the diffraction pattern of HEA before sintering, in this pattern we can see a single phase FCC. And 1b) after sintering, in which the presence of two phases are appreciated. These phases are FCC too.
Figure 2 shows the image of the optical microscope (OM) at a scale of 500x of HEA, in which the two phases formed can be observed, Fo is the dark phase and Fc is the light phase, also the presence of porosity.
Figure 3 shows the EDS chemical mapping of HEA, where it is observed that the elements of the alloy are uniformly distributed except for Cr that precipitates in certain areas. It is caused by the oxidation of Cr.

According to the results obtained, it is concluded that the alloyed powders at 100 h solidify in an FCC structure, after sintering said powders maintain the FCC structure.

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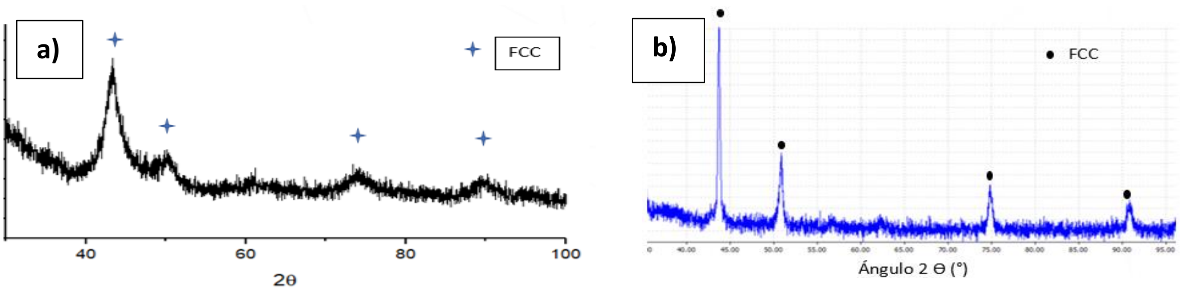

Figure 1. Diffraction pattern of HEA. a)Before sintering and b)After sintering.

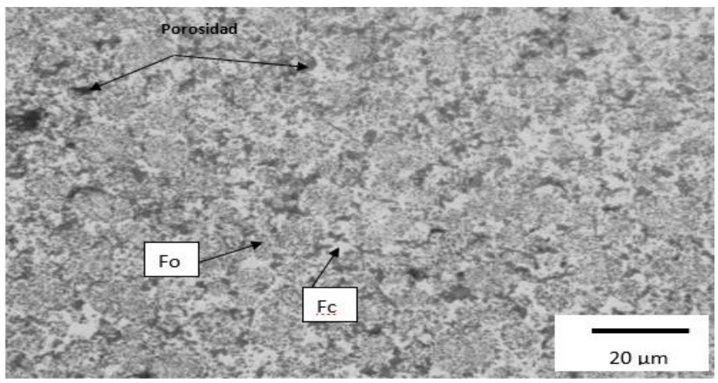

Figure 2. Image of the optical microscope (OM) at a scale of 500x of HEA

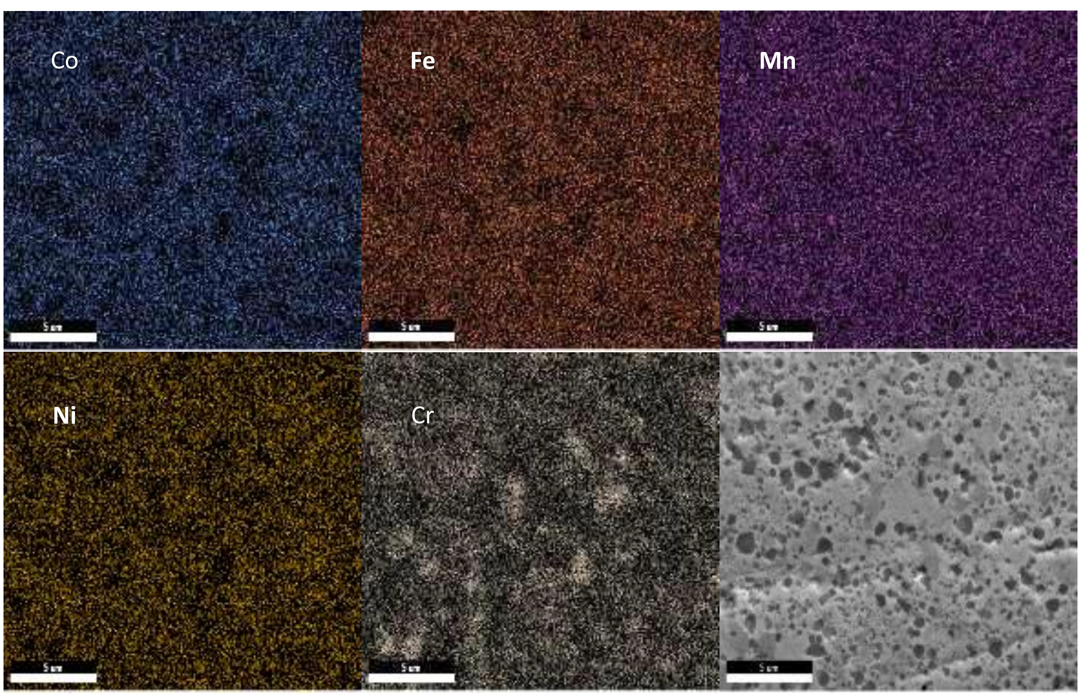

Figure 3. EDS chemical mapping of HEA.

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