Abstract

In this work it has been tried to introduce this type of new materials as reproducible industrial materials and overtake some production obstacles by exploring on the direction of chemistry structure relation.

In this thesis compacted samples have been prepared from elemental powders (Titanium, Aluminum and black carbon) by using the powder metallurgy techniques. They have been dispersed in different concentration and different molar ratios due to the change in the Ti to Al concentration. Thus the effect of Al concentration on phase evolution in the Ti-Al-C system has been investigated and discussed.

The concentrations are (10% Al-80%Ti-10%C), (20%Al-70%Ti-10%C) and (30%Al-60%Ti-10%C) and by the molar ratio target (2:1:1), (2:1.5:1) and (2:2:1) for the production of Ti2AlC and (3:1:2), (3:1.5:2) and (3:2:2) for Ti3AlC2, respectively. The load pressing used were 30 ton in cold press and 3 ton in hot press and the sintering temperatures started from (600 c˚ – 800 c˚ – 1200 c˚ and end in 1400c˚). Thus the effects of cold and hot pressing as well as sintering in different temperatures have been investigated. Phase evolution is discovered by X-ray diffraction (XRD) and SEM. Micro hardness test is used and Archimedes method is also used to measure the density and porosity percentage.

The XRD,SEM and microstructure results show that by increasing the Al concentration intermediate phases like TiAl3 and/or TiAl appear to be stable instead of the H phase. By raising the temperature, transformations accurse to produce both MAX phase structures in this system Ti2AlC and Ti3AlC2. This production pathway from the intermediate phase to ternary phase is suggested to be the more accepted, and it depends on atomic mobility. No evidence for the direct formation of MAX phases from elemental powders is found which may explain the need of high temperatures to produce such phases since the breaking of

bonds is required for the intermediate phase. Finally, the use of pre-heating process decrease the temperature of formation of the MAX phases with the effect of the highest Al concentration.