Abstract

In the recent years, a new group of ternary carbides with the general formula of $M_{n+1}AX_n$ where M is a transition metal, A is a metal from group 3-13 in the periodic table, X is either C or N and n=1-3 has gained more attention due to their unique properties. One can simply describe their properties as a combination of ceramic and metal. They are like metals with high electrical and thermal conductivity, damage tolerant and thermal shock resistant. In addition MAX phases are given some ceramic properties with high elastic modulus, high melting point and resistance to corrosion and oxidation. Many research groups try to produce and investigate through the properties of MAX phases; however, the obstacle of producing a pure phase at low temperatures is still the main issue to be overcome. Hence, although the synthesis of MAX phases is an active research area, studies that are dealing with the formation mechanisms are comparatively rare. Furthermore, researches that are treating the producing problems of MAX phases still have significant effect. The main goal of this work is to prepare the ternary carbides of MAX phases in a simplified way from industrial elemental powders. Three different systems have been studied along this goal Cr_2AlC, V_2AlC and Ti_2AlC. Cold press of mixed powders has been used to fabricate all systems. The cold pressing technique presented here can be considered as one of the

earliest researches field that dealing with such process. Sintering in an argon feeding furnace is the laboratory way to produce these structured systems. The bulk specimens have been tested using different experimental tools. The XRD results confirmed the formation of Cr_2AlC and V_2AlC with almost pure phase using cold pressing followed by sintering process. Ti_3AlC phase has not been so easy to be formed at low temperatures due to the stability of its intermediate phases within the range of this work. The SEM and optical microscopy results are used to confirm the structural features of the ternary phases and the less segregation or agglomeration. The results of sintering temperatures versus final micro hardness have been discussed in terms of mechanical properties .

Finally, the differential scanning calorimetry results over the range of 25 to 650 °C show that the reactions in all systems related directly to the Al melting point and Al diffusivity. It is obvious that the reactions in all these systems start below 600 °C which may support this attitude.

This work expected to contribute towards a better basic understanding of this fascinating class of solids. Furthermore, it has been tried to evaluate the here-proposed novel low temperature synthesis for other $M_{n+1}AX_n$ systems by cold pressing. This may release a new synthesis route for the mass production of materials with rather unique properties.