THE NATURE OF THE EARLY STAGES OF DECOMPOSITION OF ICOSAHEDRAL QUASICRYSTALS

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ABSTRACT

In this paper, following a brief review, we present some results of the early stages of decomposition of icosahedral quasicrystals and discuss the implications in the context of the stability of the quasicrystals. The new results include a possible ordering phenomenon which seems to exist in all quasicrystals. We also hypothesise a continuous mode of decomposition of magnesium based quasicrystals.

INTRODUCTION

Since the discovery of quasicrystals by Shechtman et al.[1] in the Al-Mn system, considerable efforts have been undertaken to characterise the structure of these materials using different diffraction techniques [2-4]. Recently attention is also given to elucidate the stability of these phases [5-16]. It is now clear that there exists at least two different classes of quasicrystals (and probably more). The original I phase discovered by Shechtman et al.[1] belongs to a class of Al-TM quasicrystal where TM represents transition metals. Besides Mn, quasicrystals are observed in the binary alloys of Cr, V, Ru and Fe. The alloying additions in many cases increase the stability of these i phases. In this respect the role of Si and Ce needs special mention [17,18]. It is generally believed that the basic building blocks of these phases are Mackay icosahedra which have tetrahedral and octahedral co-ordinations [19].

Ramachandraprada and Sastry [20], on the other hand, argued that Mg32(AlZn)48 structure contains a large number of icosahedra which can serve as the building block of a quasicrystal. They showed that rapid solidification leads to the formation of quasicrystals in this composition range in the Mg-Zn-Al alloys. The same argument led to the discovery of quasicrystals in Mg-Al-Cu [21], Mg-Al-Zn-Cu [22] and Mg-Al-Ag [23] alloys. The quasicrystals observed in the Al-Li-Cu and Al-Li-Cu-Mg also belong to the same category. The icosahedron inherent in these structures which can be described as Pauling triacontahedron is