



**Seminar Topic:  
TEM Study of Quasicrystalline Phases in Pellets Consolidated  
Using Spark Plasma Sintering**

**Associate Professor Dong Zhili**

**Abstract**

The production of quasicrystal powders by gas atomization has been commercialized. Among various quasicrystals synthesized, Al-Cr-Fe and Al-Cu-Cr-Fe quasicrystals are very promising materials for coatings and reinforcements in composites due to their high hardness, good wear and corrosion resistance and the relatively low cost of their constituent metals. As these quasicrystals are metal based, the behavior of bonding between the quasicrystalline reinforcement phase and the metal matrix is superior to that for ceramic phase reinforced metal-matrix composites. However, long duration sintering can result in phase changes and decrease the beneficial properties of the quasicrystals in the composites.

In our study, we employed spark plasma sintering to shorten the heating duration for the Al-Cr-Fe and Al-Cu-Cr-Fe quasicrystal powders and thus minimize the chance of phase changes when fabricating quasicrystalline reinforced composites. The phases of the sintered compacts were analyzed using x-ray diffraction. The microstructure of the quasicrystalline phases was further studied using high resolution transmission electron microscopy.

Experimental results showed that even when the heating duration was as short as 30mins during spark plasma sintering at 650°C, phase changes could still occur. X-ray diffraction patterns showed peaks from the decagonal Al-Cr-Fe phase while HRTEM images revealed that in decagonal Al-Cr-Fe quasiperiodic planes were periodically stacked along the 10-fold axis with a periodicity of about 1.2nm. Spark plasma sintering of icosahedral Al-Cu-Cr-Fe and pure Al blended powders was conducted at 450°C for 10mins and no phase change was detected using X-ray diffraction or high resolution electron microscopy. This implies that spark plasma sintering is effective in fabricating quasicrystal reinforced Al-based composites.

**Biography**

Dr Dong Zhili received his BEng and PhD degrees from Tsinghua University in 1984 and 1989 respectively. He received the Japanese Government scholarship in 1987 and 1988, and completed his PhD thesis at Tsinghua University and Osaka University under the Joint PhD Program of the Ministry of Education of China. He was trained as a Materials Engineer and Scientist during his undergraduate and postgraduate studies. Prior to joining the School of Materials Science & Engineering in Nanyang Technological University, Dr Dong worked at the Environmental Technology Institute as Senior Research Scientist, School of Mechanical and Production Engineering in NTU as Research Fellow, University of Barcelona as Visiting Professor and Tsinghua University as Lecturer. He subsequently developed his research in the areas of materials engineering, crystal structure/electronic structure-property relationships, and interface structure analysis at Tsinghua University, the University of Barcelona, Nanyang Technological University and A\*STAR. He has more than thirty years experience in X-ray diffraction and transmission electron microscopy of materials. He has authored and co-authored over 200 journal papers in these areas. His teaching is mainly on (1) Crystallography, (2) X-ray diffraction and (3) Transmission electron microscopy of materials. Dr Dong also serves as an Executive Board Member of Asian Electroceramics Association.

**Wednesday, 20 January 2021 || Time: 2:00 pm - 3:00 pm ||**  
**Live Streaming Link (Zoom Meeting): <https://ntu-sg.zoom.us/j/94741522430>**  
**Meeting ID: 947 4152 2430 Passcode: 200121**  
**Hosted by: Associate Professor Huang Yizhong**