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Magnetism induced by structural disorder in the icosahedral quasicrystal $Al_{64}Cu_{23}Fe_{13}$

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Quasicrystals, discovered only a few decades ago, transformed crystallography by proving that solids can show rotational symmetry without periodic repetition [1]. A well-known example is the Al–Cu–Fe alloy, whose icosahedral structure differs greatly from conventional crystals. In these materials, domains, interstitial regions, and defects strongly influence their physical properties, especially magnetism [2]. This study examines the $Al_{64}Cu_{23}Fe_{13}$ quasicrystal, produced by arc melting and later nanostructured through mechanical milling. X-ray diffraction confirmed that the quasicrystalline phase remains stable after nanostructuring. Magnetic measurements using VSM (50–300 K) revealed that saturation magnetization increases as temperature decreases, mainly due to reduced domain size and magnetically active interstitial sites. The results show that nanostructuring enhances the magnetic response of Al–Cu–Fe quasicrystals, a behavior further confirmed by the ZFC–FC analysis. These findings highlight their potential for technological applications, particularly in spintronics, where their aperiodic structure can improve spin-dependent electron transport and enable more effective control of spin states.

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