FORMATION OF INTERSTELLAR C_{60} FROM SILICON CARBIDE CIRCUMSTELLAR GRAINS

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The positive detection of buckminsterfullerene (C_{60}) in circumstellar and interstellar environments has changed paradigms of chemical complexity in the hostile conditions of space. While C_{60} is a significant sink of interstellar carbon, the formation mechanism is still the subject of speculation. To examine C_{60} formation, we have conducted shock-heating experiments on synthetic, 3C-SiC grains, the most common polytype generated by stars. Measurements of the heated grains, conducted with transmission electron microscopy (TEM) and electron energy-loss spectroscopy (EELS) techniques, show the formation of graphite and carbon nanobuds on the sample surface. The nanobud diameters are nearly identical to that of C_{60}, indicating that spherical structures may be forming as well. These data suggest that C_{60} is formed by the shock-heating of common SiC grains at the end of the asymptotic giant branch (AGB) phase. In addition, TEM measurements of actual pre-solar grains extracted from meteorites show a central SiC core, surrounded by graphite, confirming our proposed formation mechanism.