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Identification and lattice location of oxygen impurities in  $\alpha$ -Si<sub>3</sub>N<sub>4</sub><sup>1</sup> MARK P. OXLEY, JUAN C. IDROBO, Vanderbilt U., W. WALKOSZ, ROBERT F. KLIE, SERDAR OGUT, University of Illinois at Chicago, BILJANA MIKI-JELJ, Ceradyne Inc., STEPHEN J. PENNYCOOK, ORNL, SOKRATES T. PAN-TELIDES, Vanderbilt U. — For over 40 years impurities have been believed to stabilize the ceramic  $\alpha$ -Si<sub>3</sub>N<sub>4</sub>, but there is no direct evidence for their identity or lattice location. In bulk materials electron microscopy can generally image heavy impurities. Here we report direct imaging of N columns in  $\alpha$ -Si<sub>3</sub>N<sub>4</sub> that suggests the presence of excess light elements in specific N columns. First-principles calculations rule out Si or N interstitials and suggest O impurities, which are then confirmed by atomically-resolved electron energy-loss spectroscopy. The result provides a possible explanation for the stability of  $\alpha$ -Si<sub>3</sub>N<sub>4</sub> with implications for the design of next-generation structural ceramics.

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