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# Microstructure and fracture mechanism of low density ceramic proppants

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## Abstract

Solid wastes coal gangue and magnesium slag were added to prepare low density ceramic proppants at sintering temperatures below 1300 °C. The addition of solid wastes greatly decreases sintering temperature and preparation cost. The morphology and phase composition of the proppants were examined by scanning electron microscopy (SEM) and X-ray diffraction (XRD). The results show that the main crystal phases of the proppants are granular corundum and rod-like mullite, and the proppants have better sphericity. Furthermore, the most suitable sintering temperature is 1250 °C, and the resulting ceramics exhibit transgranular fracture. This means that rod-like mullite crystals provide strong toughening and reinforcing effects.

**Keywords:** Ceramics; Sintering; Coal gangue; Magnesium slag; Fracture mechanism

## 1. Introduction

Proppants, required in hydraulic fracturing operations in the oil or gas industry, consist of millimetre-sized ceramic particles used to “prop open” rock cracks to increase oil well production [1, 2]. To be effective they should be strong and should break into few fragments. To flow readily they should also be accurately spherical and uniform in

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