

Title: Calculations of the Stress Field around a Sinter-Crack

Paper Number: 056

Authors: Joseph R. Carazzone, Zachary C. Cordero

Abstract: The buildup of stress in a sintering powder leads to cracking when it is amplified by stress concentrating features. This is particularly problematic for powder aggregates possessing complex design geometries, such as those produced by binder jet 3D printing or metal injection molding. To quantify this phenomenon, we use the discrete element method to simulate the evolution of sintering specimens having traditional fracture mechanics geometries and known stress parameters. The method allows a direct look at the stress state in the sintering material, revealing how stress concentrates ahead of a design flaw. By following the crack emanating from the flaw, we find a correlation between the crack tip position and the maximum local stress. Finally, we test a fracture mechanics parameter for its ability to describe the stress field ahead of the flaw. The ability to predict this field can lead to design guidelines for avoiding cracking during sintering.

Keywords: Solid State Sintering, Fracture behavior, Stress analysis

Corresponding Author: zc29@rice.edu; 713-348-2904

1. Introduction

The 3D-printing technique known as binder jetting brings into new light the materials processing route of sintering (1). Binder jetting shows promise as an industrial solution by offering faster print times and energy savings due to its ability to print objects without focused energy sources such as a laser or electron beam. The printed objects can then be efficiently post processed in a