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## Agglomerate crack propagation under micro-compression as seen by phase-contrast tomography

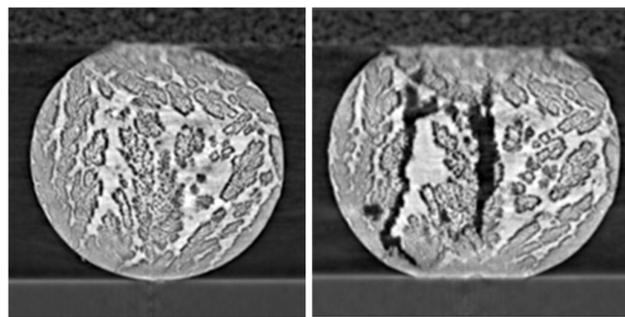
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The reference ceramic fabrication process behave three main stages, grinding, pressing and sintering. The macroscopic pellet compaction (pressing) is based on three main densification step, rearrangements by motion, compaction by strain and agglomerate fractures by compression. The powder took into account in this study is composed of agglomerates with a microstructure based on a mixt homogeneous of  $\text{TiO}_2\text{-Y}_2\text{O}_3$ . Each agglomerates have a microstructure composed by un-breakable elementary particles include in breakable aggregates. The agglomerates have been synthetized by the Cryogenic Granulation Synthesis Process (CGSP), [1], which enables to obtain convex agglomerates with the homogeneous and porous parts. To consider the microstructure behaviour of agglomerates powders and their composition, the multi-scaling is used and based on the interactions between agglomerates and fracture phenomena inside the agglomerates due to the ultimate step during the compaction. Macroscopic models are usually used in Finite Element Method (FEM), [2], simulations for the industrial pellet scale. Microscopic models are used in Discrete Element Method (DEM), [3], simulations where powder's granular microstructure is directly taking into account for established the finest behaviour law. To manage these laws in FEM simulations, homogenization is done on Elementary representative volume (ERV) to mesoscopic scale. In this context, an investigation has been done to understand agglomerates breakage mechanisms. To do that, experimentations based on agglomerate micro-compressions on tomograph in Anatomix X ray beam line synchrotron Soleil has been carry out, [4]. This study is the result of a collaboration between Strasbourg University (Unistra), Anatomix beam line (Soleil synchrotron) and atomic energy office (CEA) teams. These teams pooled their skills for these investigations. The results are in agreement to Kendall's theory, which argued that the fracture of granule is a consequence of crack nucleation at flaws leading to subsequent crack propagation through the granular structure. The  $340\mu\text{m}$  agglomerate diameter was investigated by one-way cyclic micro-compression test and other agglomerates with a simple load and unload cycle until breakage have been tested. The tomographic post-treatments have enabled the porosities volumes and surfaces created after breakage, the origin of the main crack and its propagation, **Fig 1**.



**Fig 1: tomography Agglomerate before breakage (left), after breakage (right)**

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