Optimization of Electro Pulsing on Yttria-Stabilized Tetragonal Polycrystalline Zirconia (3Y-TZP) Ceramic Water Filter Sintering

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This project includes the utilization of electro pulsing to optimize the production of ceramic filters, specifically Yttria-Stabilized Tetragonal Polycrystalline Zirconia (3Y-TZP). Due to the versatility of this ceramic, pore sizes can be controlled to filter out particulates, bacteria, viruses, and other pathogens. However, current ceramic sintering processes require long sintering times and extensive energy costs when heating furnaces at high temperatures. Furthermore, current ceramic water filters are unable to attain the miniscule pore sizes required to filter viruses. This study sought to shorten sintering time, reach a target pore size of 20 nanometers, and achieve full density. The sintering process was optimized by varying voltage, duration, and electro pulsing frequency. At 40V, 10 microsecond pulses, and 70 Hz at 1400°C for 3000 minutes, the microstructure data showed that the pore size did achieve 20 nanometers and full density. Activation energy of space-charged clouds increased to slow the grain growth, which allowed full density at a smaller pore size. In addition, the sintering time was decreased from 7200 minutes to 3000 minutes, making the process very cost-effective. The use of electro pulsing to produce ceramic water filters is an efficient method and allows for potable drinking water to be more accessible.

Awards Won: