



# Ultrafast High-temperature Sintering (UHS)

Reduces energy consumption and manufacturing time. Offers the ability to improve material's microstructure and properties.

## Institution



CEITEC, Brno University of Technology

## Development Status

Laboratory-validated;  
Technology Readiness Level (TRL) 3 to 4.

## IP Protection Status

Know-how and procedures protected as proprietary expertise.

## Partnering Strategy

Available for industrial and academic collaboration, possible co-development, spin-off.

## The Problem

Conventional sintering techniques include prolonged exposure to high temperatures, often requiring hours to achieve full densification. This results in excessive energy consumption, long manufacturing times, and microstructural coarsening that degrades mechanical and functional properties. UHS overcomes these limitations by drastically shortening the thermal cycle to seconds or minutes, thereby reducing energy costs and preserving fine microstructures that are critical to performance. The process also minimizes loss of volatile elements and reduces unwanted dopant segregation, allowing for the stabilization of metastable or volatile compositions that are otherwise difficult to retain using conventional approaches.

## Technology Description

The UHS apparatus consists of an airtight chamber that houses a graphite felt used as the heating element. The chamber can be connected to either a gas supply or a vacuum pump, allowing for a wide range of sintering atmospheres. Heating of the graphite felt is regulated by an external power supply. The ceramic or glass powder compact is positioned within a small horizontal slit (or pocket) in the graphite felt. Due to its porous structure and low thermal mass, the graphite felt can be rapidly heated to the desired sintering temperature within a few seconds upon application of an electric current.

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Wang et al., Science 368, 521-526 (2020)

The estimated heating rate is on the order of  $10^4$  °C/min. UHS can be applied to a wide range of advanced ceramics and glasses, operating at temperatures up to 3000 °C. Owing to its ultrafast heating and cooling capabilities, the entire sintering process typically completes in less than 60 s.

## Commercial Opportunity

UHS offers clear industrial value by markedly lowering overall energy consumption and providing a scalable pathway for efficient, high-throughput manufacturing of next-generation ceramic components. UHS is ideal for fast testing of new material compositions and dopant effects, supporting accelerated R&D cycles in advanced ceramics.