

New research may revolutionize ceramics manufacturing

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Researchers from North Carolina State University have developed a new way to shape ceramics using a modest electric field, making the process significantly more energy efficient. The process should result in significant cost savings for ceramics manufacturing over traditional manufacturing methods.

Ceramics make up significant components of an array of products, including insulators, spark plugs, fuel cells, body armor, gas turbines, nuclear rods, high temperature ball bearings, high temperature [structural materials](#) and heat shields.

At issue are crystalline defects found in [crystalline materials](#), such as ceramics. "One of these defects is called a grain boundary, which is where crystals with atoms aligned in different directions meet in the material," says Dr. Hans Conrad, emeritus professor of materials science and engineering at NC State and co-author of the study. These boundaries have electrical charges.

"We found that if we apply an electric field to a material, it interacts with the charges at the [grain boundaries](#) and makes it easier for the crystals to slide against each other along these boundaries. This makes it much easier to deform the material." In other words, the material becomes superplastic - so a [ceramic](#) can be shaped into a desirable form using a small amount of force.

"We've found that you can bring the level of force needed to deform the

[ceramic material](#) down to essentially zero, if a modest field is applied," Conrad says. "We're talking between 25 and 200 volts per centimeter, so the electricity from a conventional wall socket would be adequate for some applications."

These findings mean that manufacturers who make anything out of ceramics will be able to do so using less energy. "It will make manufacturing processes more cost-effective and decrease related pollution," Conrad says. "And these findings also hold promise for use in the development of new ceramic body armor." Conrad is planning to do additional work using this approach to fabricate ceramic body armor with better properties at a lower cost.

More information: The research, "Influence of an applied dc electric field on the plastic deformation kinetics of oxide ceramics," is published in the journal Philosophical Magazine.

Provided by North Carolina State University

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