Ceramic material revs up microwaving

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Quicker microwave meals that use less energy may soon be possible with new ceramic microwave dishes and, according to the material scientists responsible, this same material could help with organic waste remediation.

"Currently, food heated in a microwave loses heat to the cold dish because the dishes are transparent to microwaves," says Sridhar Komarneni, distinguished professor of clay mineralogy, College of Agricultural Sciences at Penn State. "The plates are still cool when the cooking is completed."

Materials are transparent to microwaves because the microwaves do not interact with the molecules in standard tableware. With liquids like water, the microwaves cause the molecules to move back and forth creating heat.

Komarneni, working with Hiroaki Katsuki and Nobuaki Kamochi, Saga Ceramic Research Laboratory, Saga, Japan, developed a ceramic from petalite and magnetite sintered together that heats up in the microwave without causing equipment problems the way most metals do.

They report their material in a recent issue of *Chemistry of Materials*.

Petalite is a commonly occurring mineral that contains lithium, aluminum and silicon and is often used to make thermal shock resistant ceramics because it expands very little when heated. Ceramic sintering uses powdered minerals pressed together hard to form green bodies.

These green objects are fired first at low and then high temperatures.

When the petalite and magnetite are fired together, the magnetite converts to an iron oxide that heats up when placed in a microwave.

A rice cooker made of this material cooked rice in half the time it normally takes in a non-heating microwave rice cooker.

"Rice cooks very well with these dishes," says Komarneni who is also a member of Penn State's Materials Research Institute. "Dishes heated by themselves or with food could keep the food hot of up to 15 minutes. One might even cook a pizza on a plate and then deliver it hot."

However, those accustomed to cooking in a microwave will need to remember that the plates are hot and will burn bare hands. Potholders are again necessary.

Food preparation applications abound. A company in Arita, Japan -- long a locus of ceramic manufacturing -- called Asahi Ceramics Research Company is manufacturing microwave ware.

The material's microwave heating properties suggest another use. Because the material expands very little when heated, the petalite magnetite material does not shatter under rapid microwave heating and cooling as other materials might. The researchers created a plate of the petalite magnetite ceramic and coated the solid plate structure with cooking oil. After heating for 120 seconds, 98 percent of the oil was gone, decomposed into its components.

"We used cooking oil because it is an innocuous substance," says Komarneni. "We could, perhaps, use this material in a closed system to decompose organic contaminants in soil or dirt."

The researchers believe that once optimized, the material could be used for a variety of remediation applications at a lower energy cost and with less residue than many current methods.

Source: Penn State