Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

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Microwave Radiation-Compatible Raman Probe

Microwave-assisted synthesis is a modern method of heating substances rapidly and with high energy efficiency. Applications in solid state chemistry is a growing field of research rapidly gaining popularity with microwave heating being used to synthesize a plethora of inorganic compounds. As a result of its time- and energy-efficiency, it can also be used to rapidly screen the phase space of inorganic materials which enables the discovery of new (potentially metastable) compounds.

Currently, microwave-assisted synthesis is considered a "black-box" and scientists desire to understand more about it. The lack of understanding is partly due to a lack of tools available to monitor microwave reactions in situ. For example, commercially available Raman probes cannot be used within microwave reactors due to the use of incompatible metallic components. For in-situ studies, researchers rely on synchrotron-based in-situ setups, e.g., using X-rays. Synchrotron measurements are generally expensive, time-consuming, and not readily available. What is needed is an instrumentation that brings in-situ Raman measurements during microwave processes to laboratories.

Researchers at Arizona State University have developed a Raman probe composed of microwave-compatible materials which can be used to collect Raman spectra. This Raman probe enables in situ Raman spectroscopy which can provide chemical identification and temperature information during a reaction providing valuable insights into the formation of products, accelerate optimization procedures, and aide in quality control of industrial products. The probe can be easily adapted to laboratory and industrial Raman instruments and microwave reactors. The probe will allow for researchers to apply in situ Raman spectroscopy to microwave-assisted solid-state reactions.

Related publication: Development of a Raman spectroscopy system for in situ monitoring of microwave-assisted inorganic transformations

Potential Applications:

- Raman probe for integration into a Raman instrument (i.e., a Raman spectrometer)

Benefits and Advantages:

- Flexible solution that can be adapted to existing Raman instrumentation
- Designed to operate in common laboratory microwave reactors
- Tolerant of high temperatures and high microwave irradiation
- Composed of microwave-transparent materials
- Probe was tested during anatase-to-rutile phase transition in TiO_2 at temperatures exceeding 800°C