Scientists confirm how crystals form

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A team of researchers at Yale University is the first to devise a way to predict the microstructure of crystals as they form in materials, according to a report in the September issue of *Applied Physics Letters*.

Although there are theoretical models that predict grain size and ways to monitor the growth of individual crystals, this new method makes it possible to estimate grain size and therefore the properties of materials that are dependant on microstructure.

Researchers in many fields including materials science, geology, physical chemistry and biochemistry will now be able to tailor material properties that are sensitive to microstructure.

According to senior author Ainissa G. Ramirez, assistant professor of mechanical engineering, the Yale team monitored real-time images taken at two-second intervals while they heated crystallizing samples of nickel-titanium within a transmission electron microscope.

They directly determined the rate of crystal assembly (nucleation), and the rate that the crystals grew, by measuring the number of crystals and their change in size with time. Their results agree with the conventional Johnson-Mehl-Avrami-Kolmogorov method which only gives an overall crystallization rate, with the nucleation and growth rates coupled.

The novel contribution of this work is that the nucleation and growth rates are measured independently during crystallization and can be used to infer the grain size after crystallization is complete.

"We used the mathematics of crystallization in a new way," said Ramirez. "We found that our measured grain sizes and the mathematical predictions agreed over a broad range of temperatures. This method allows researchers to now explore the connection between structure and properties of different materials."

Source: Yale University