X-REPORTS IN THERMAL SCIENCE AND ENGINEERING

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Introduction to X-Reports

In recent years, the thermal science and engineering field has greatly expanded and now overlaps with other branches of science, such as physics, material science, biomedical science, nanotechnology, big data, and artificial intelligence. High-level interdisciplinary research demands closer connections and cooperation among global researchers working on a wide range of subjects. Webcam meetings enable global scholars to easily come together to discuss and cooperate on these crucial topics. The X-Reports aim to invite distinguished professionals from various disciplines and countries to give cutting-edge/breakthrough lectures on an interactive platform to encourage new ideas and promote innovations in thermal science and engineering.

3rd X-Report

Prof. Gang Chen

Massachusetts Institute of Technology, U.S.

Title: Phonon-engineered extreme thermal conductivity materials

Time: 9:00-11:00 am, September 26 (Beijing Time), 2020

Webinar Meeting Code No.: 661 6843 5566 (ZOOM ID)

Website: http://www.xreports.org

Abstract

Ultrahigh or ultralow thermal conductivity materials are desirable for many technological applications such as thermal managements of electronic and photonic devices, heat exchangers, energy converters and thermal insulations. Recent advances in simulation tools and experimental techniques have led to new insights on phonon transport and scattering in materials, discovery of new thermal materials, and are enabling the engineering of phonons towards desired thermal properties. This talk will start with discussion of the discovery of high thermal conductivity materials such as boron arsenide and isotopically enriched cubic phase boron nitride with measured room temperature thermal conductivity values ~1200 W/m-K and ~1600 W/m-K, respectively, representing the best noncarbon-based heat conductors.

It will then proceed to demonstrate molecular engineered polymer fibers and sheets with measured thermal conductivity values two orders of magnitudes higher than their normal values. In the opposite direction, the talk will show how to explore the localization of phonon waves in superlattices with nanodots to achieve lower thermal conductivity. The materials discussion will be accompanied by explanation of different heat conduction regimes beyond Fourier law of diffusion, summarized in a regime map pointing to directions and physical mechanisms to achieve extremes of thermal conductivities.