Heat transport in two-dimensional heterostructures studied using Raman thermometry

Alois Arrighi[1,2], J.S. Reparaz[1], Z. Messele[1,2], C.M. Sotomayor Torres[1,3] and S. O. Valenzuela[1,3]

[1]Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC and The Barcelona Institute of Science and Technology, Campus UAB, Bellaterra, 08193 Barcelona, Spain
[2]Universitat Autonoma de Barcelona, 08193 Bellaterra (Barcelona), Spain
[3]ICREA - Catalan Institute for Research and Advanced Studies, 08010 Barcelona, Spain

alois.arrighi@icn.cat

Abstract

In order to study the thermal properties of 2-dimensional materials such as graphene and h-BN we have fabricated a series of free-standing samples adapting a standard mechanical transfer method [1] to a free-standing geometry. Several transfer processes based on different polymers have been tested as for example PMMA, PPC. As support platform we have designed and fabricated a series of holy Si substrates with holes of circular geometry and different diameters ranging from 5 to 50um. Whereas the BN samples were fabricated by direct exfoliation, the grapheme samples were grown on Cu substrates using chemical vapor deposition and subsequently transferred to the hoy substrates. The thermal conductivity of the samples was measured using a state-of-the art thermal characterization technique, two-laser Raman thermometry [2], a contactless method based on a two laser approach. In addition to the thermal conductivity we could also obtain thermal maps which directly show how heat is dissipated, upon a localized excitation, to the 2-dimensional flakes and to the substrate. In addition, this technique allowed us to study the higher temperature regime close to 1000 ºK, which results almost impossible using alternative approaches.

References

[1] A Castellanos-Gomez, M. Buscema, R. Molenaar, V. Singh, L. Janssen, H.S.J. van der Zant and G. A Steel, 2D Materials, **1** (2014).

[2] J.S. Reparaz, E. Chavez-Angel, M.R. Wagner, B. Graczykowski, J. Gomis-Bresco, F. Alzina and C.M. Sotomayor Torres, Review of Scientific instruments, **85** (2014).