This thesis focuses on Boron Nitride (BN) and Carbon Nitride (CN) thin film nanostructuring. Inspired from its carbon counterpart, BN and CN nanocrystal orientation can be tailored in order to align themselves in the vertical direction. This material "texturing" at the nanoscale opens new interesting properties in materials and the synthesis and properties of textured BN and CN is studied in this work.

Firstly, a new growth method based on High Power Impulse Magnetron Sputtering (HiPIMS) was created in order to growth BN thin films: A Lanthanum Hexaboride (LaB_6) target was reactively sputtered in argon and nitrogen gas. Under specific growth conditions, dependant on temperature and sputtering power density, h-BN nanocrystals with the basal planes aligned in the vertical direction were obtained. The growth mechanism involving the change in alignment to produce vertically ordered BN (voBN) was studied and attributed to the compressive stress applied on the film during growth, where the maximum amount of stress would produce the best alignment. This novel crystalline structure displayed an improvement in thermal conductivity (TC) in the through plane direction by a factor 3 (at 5.1 $W.m^{-1}.K^{-1}$) compared to a randomly aligned BN film (1.7 $W.m^{-1}.K^{-1}$), and it was attributed to the vertical texturing, which facilitates the phonon transport in the through film direction.

In order to verify the assumption that the phonons move preferentially along the basal planes in the vertical direction, additional thermal characterization was performed using 3 omega, ascertaining an anisotropy in thermal transport with an in plane TC of 0.26 $W.m^{-1}.K^{-1}$, while the through plane TC was found to be 16 times greater at 4.26 $W.m^{-1}.K^{-1}$. Molecular Dynamics (MD) simulations was used to successfully re-enact the TC anisotropy observed experimentally, attributing the difference to the many interfaces between crystalline and amorphous regions and the preferential phonon propagation along the vertically ordered crystalline basal planes. COMSOL Multiphysics simulations were used to quantify the performance of voBN at preventing heat cross talk, allowing an increase by a factor 4 in hot spot density compared to SiO_2, without inducing any temperature increase.

Finally, a similar nanostructuring tuning was accomplished with CN, using reactive HiPIMS of a carbon target in argon and nitrogen atmosphere. The phonon response depending on the film structure was studied using Transient Grating Spectroscopy (TGS) to locally excite the material and study its thermal response. Pure carbon films, together with CN films where produced with amorphous and vertically ordered structure in order to compare their phonon response. Vertically ordered CN (voCN) exhibited and enhanced through plane TC compared to a-CN with a greater value by a factor 10 (1.5 $W.m^{-1}.K^{-1}$). This increase in TC can be linked to both the increased graphitic structure of the films, which facilitates the phonon transport as well as the vertical ordering of the planes helping to focus the phonon propagation in the through plane direction.