Nanotechnology for Oil and Gas: bridging the gap between fundamental science and industrial solutions

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The life of a physicist in the industry can be both exciting and humbling for its complexity. Oil and Gas is an example of a trillion dollar, very competitive industry that depends on an accurate understanding of the physical world – the physical processes within it – and also on the effective execution of technologies at a scale that defies our intuition.

To make significant contributions to this industry, progress along the entire spectrum between fundamental science and applied technology is required. In this seminar, I will present a set of ongoing projects at IBM Research - Brazil covering most aspects of such an endeavour.

On the fundamental science front, the study of oil nanodroplets on a glass surface allows us to understand how liquid-solid interactions affect the droplet shape, wettability and energetics. The experimental work involves nanoscale microscopy methods, while the computational work involves molecular dynamics simulations and statistical mechanics numerical models.

On the applied physics front, we introduced a method and a device that allows to spatially resolve liquid flow by integrating an array of graphene-based magnetic sensors that is used for tracking the movement of magnetic nanoparticles immersed in the liquid under investigation, in what we call “Magnetic Nanoparticle Velocimetry”.

On the industrial solutions front, we are developing a cloud-based computational platform to integrate the analysis of the porous structure of oil reservoir rocks as obtained by a digital tomography, the simulation of nanoscale fluid flow in a porous network and the AI-powered recommendation of flow enhancers from a materials database.

By creating ready-to-use technologies we can ensure that years of work and investigation reach the industry and enhance its productivity.