

# Zernike Colloquium

November 2<sup>nd</sup> 2023

16:00h

5111.0080

## Building Tomorrow's Electronics:

## From Atoms to Devices



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Moore's scaling law has survived during more than 50 years because the transistor fabrication recipes have been continuously adapted and technology boosters have been gradually introduced. The driving force behind these innovations has always been the intuition of clever researchers who benefited from the support of technology computer aided design (TCAD) tools to verify their predictions. These tools have been used in the semiconductor industry since the end of the 1970's. Over the last 40 years, transistors have undergone tremendous evolutions, their dimensions being reduced by several orders of magnitude, while the physical models at the core of commercially available device simulators have remained the same: the electron transport properties are still described at the classical level with quantum mechanical corrections to account for geometrical confinement or tunnelling currents.

To accurately model nano-devices, reproduce their characteristics, and predict their performance even before they are fabricated, a new generation of advanced TCAD tools is needed. It should rely on atomistic quantum mechanical concepts to properly describe the physics and geometries at play. In this talk, the challenges and opportunities of the TCAD research activity will be discussed before introducing our in-house tool and illustrating it with a relevant application, valence change memory cells. It will be shown that in order to shed light on the behavior of these memristive devices, molecular dynamics, kinetic Monte Carlo, density functional theory, and quantum transport should be combined. Exemplary results will be presented to demonstrate the capabilities and the potential of the developed approach.

Coffee from 15:30h  
Drinks & Snacks after



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 groningen

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 and engineering

