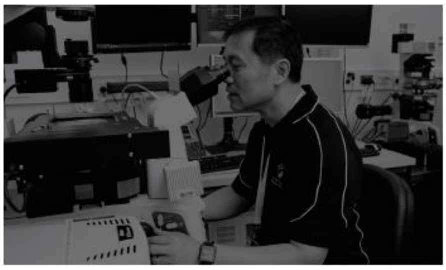

Tuning light-matter interactions with infrared optical resonators

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11:00am, 28/05/2024
Melbourne Centre for Nanofabrication
151 Wellington Road, Clayton, 3168
Zoom link: click here
Meeting ID: 813 1921 9041 and passcode: 258765

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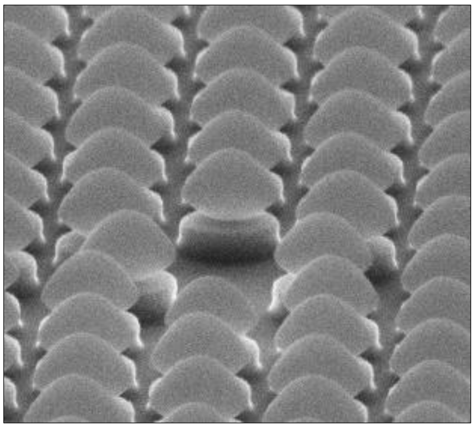
Abstract:
Light-matter coupling in the visible is, today, a well-understood area of research. We have many good materials that can strongly interact with visible light, many materials that are transparent in the visible, and reliable and cost-effective visible light sources and detectors. In contrast, the infrared is the wild outback for light-matter interactions. With a constant weak thermal background, almost every material interacts with infrared, but only weakly, and there are only limited and extremely expensive IR light sources and detectors. Therefore, there is a need to tame this wilderness to facilitate light-matter interactions properly! In addition, there are many additional benefits in the infrared: photolithography-compatible device fabrication, covert optical communication, encryption and storage, directed global cooling, and label-free sensing.

In my talk, I will discuss a rational design of plasmonic templates for weak-light matter applications, also known as Surface-enhanced Infrared absorption spectroscopy (SEIRA). I will discuss common problems encountered in SEIRA, such as Fano distortions, peak shifts, and low sensitivity, and give an outlook for large-scale fabrication of plasmonic templates in the infrared.



Further, I will discuss novel systems for vibrational strong light-matter coupling based on freestanding and flexible PET films. Strong light-matter interaction results in the formation of quasi-particles known as polaritons. A polariton represents a hybrid entity, partially light and matter, coherently linking something we perceive as dominantly dynamic (light) to something more static (material). As a hybrid state between light and matter, polaritons exhibit properties distinct from those of their material counterparts and vice versa.

Finally, I will introduce dual resonant optical cavities for optical encryption, featuring independently tunable resonances in the visible and near-infrared spectra, suitable for covert optical applications.

All these projects are ongoing collaborations with ANFF-VIC, and the facilities at MCN are critical to the success of these projects.

References:

[1] Akinoglu, G. E.; Akinoglu, E. M.; Kempa, K.; Hutchison, J. A., Materials design of vertically coupled plasmonic arrays. *Nanoscale Advances* 2021, *3* (24), 6925-6933.

[2] Akinoglu, G. E.; Hutchison, J. A., Perspective—quasi-babinet complementary plasmonic templates: A platform to perform spectroelectrochemistry. *ECS Journal of Solid State Science and Technology* 2021, *10* (3), 035005.

[3] Akinoglu, G. E.; Hutchison, J. A, Tuning Light–Matter Interactions with Mid-Infrared Plasmonic Coaxial Apertures. Applied Optical Materials 2023, 1,3,771-778

Engin Akinoglu is a PhD student under the supervision of Dr. James Hutchison at the University of Melbourne. He earned a master's degree in chemistry from Trinity College Dublin and another in Physics from the Free University of Berlin. His research focuses on polaritonics, plasmonic light-matter interactions, and nanofabrication.