Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **2632** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

# Epitaxial Growth of Single Crystal Noble Metals for Plasmonic and Nanophotonic Applications

*Monday, June 3, 2019 2:30 PM (15 minutes)*

Material quality and crystallinity play an important role in the activity of plasmonic devices. Plasmonic structures made from monocrystalline metals may be expected to display much higher efficiency and stability than polycrystalline devices which are subject to many losses due to the presence of grain boundaries and defects. With the help of a novel epitaxial electroless deposition (EED) chemistry, ultrasmooth gold films can be grown on monocrystalline silver surfaces. In this approach, the electrochemical incompatibility of gold and silver can be overcome in concentrated sodium hydroxide (NaOH) (1 M) where the presence of $OH^-$ causes a decrease in the reduction potential of gold cations by forming $Au(OH)_4^-$ complexes (E≈0.55 V), an increase in the oxidation potential of the silver electrode (E≈1.45 V), and acts as a reducing agent. As a result, ultrasmooth monocrystalline gold films are grown with the same crystalline orientation as the underlying silver film. This chemistry enables the growth of gold from a few monolayers up to few hundreds of nanometers uniformly over a large area. Furthermore, this approach enables the fabrication of large area metasurfaces made of gold and silver epitaxially grown nanostructures that can be used in a variety of different applications. The growth of gold films and nanostructures can also be manipulated by the introduction of anionic species during the deposition, and leads to the formation of surface nanostructures with specific shape, due to preferential interaction of the anions with certain facets of the growing crystalline structures.

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**Session Classification:** M2-1 Interaction Between Matter and Light (DAMOPC) | Interaction de la matière et de la lumière (DPAMPC)

**Track Classification:** Division of Atomic, Molecular and Optical Physics, Canada / Division de la physique atomique, moléculaire et photonique, Canada (DAMOPC-DPAMPC)