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# Liquid metal alloy catalyst in propane dehydrogenation

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**ABSTRACT**

*Propane dehydrogenation is one of the most impactful chemical processes in producing propene, which is the building block for polymer and petrochemical industries. This reaction relies on the utilisation of valuable noble metals, especially platinum-based catalyst, to achieve a high kinetic reaction rate at an elevated temperature of 500-700℃. However, the rapid deactivation of the catalyst can be caused by sintering and coking issues of noble metals at high operating temperatures. The emerging solution could be discovering a new class of catalyst that is able to effectively and affordably promote high catalytic activity to reduce the use of valuable noble metals as well as the coking issue. Liquid metals, which are in liquid form at around room temperature, are one of the promising underexplored ranges of catalysts that have unique characteristics of both solid metallic and liquid materials. Having low entropy and negative mixing enthalpy compared to other metals, liquid metals offer a high advantage and flexibility in alloying strategy with different combinations and differenet types of structure that can facilitate heterogenous catalysis with superior performance. It has been claimed that liquid metals can promote the activity of other metals and the incorporation of transition metals with liquid metals can generate highly active materials. Hence, liquid metal alloys create a huge opportunity to turn cheap and highly abundant transition metals into higher catalytically active materials in a wide range of reaction applications, hence potentially minimise or eliminate the use of low abundant and expensive noble metals. Existing studies have been investigating and suggesting that the thermocatalytic activity of gallium or PtGa that is embedded on inert supports for propane dehydrogenation has been showing positive results for liquid metal alloy catalysts. However, to further explore the superiority and benefits of liquid metal catalysts, the incorporation with non-active or low-active metallic elements can be investigated to discover the potential of utilising liquid metal in enhancing the reaction efficiency. The interaction between liquid metal and other components could lead to many different modulation possibilities in their electronic properties and synergy, hence, promotes the catalytic activity. We have been studying and developing not just different bimetallic (CuGa, CoGa, AgGa), but also multimetallic (AgCuGa) liquid metal alloys to seek the right candidate for propane dehydrogenation. In this work, we also introduce our novel technique of planet-like nanodroplet synthesis utilising ultrasonication at high temperatures and a supported catalytically active liquid metal solutions (SCALMS) platform in catalysis.*

**KEY WORDS**

*Liquid metal, alloy, catalyst, propane dehydrogenation*

**BIOGRAPHY**

*My Linh Phuong received her Bachelor of Engineering (Chemical Engineering) (Honours) degree from RMIT University, Australia in 2023. She graduated with First Class Honours and was the runner up for the best final year chemical engineering design project (Pratt Prize 2024) in Victoria. After graduating, she started her PhD study at RMIT University in 2024 focusing on liquid metal catalysts for low emmision applications. The objectives in her current study is to furtheer explore the catalytic activity of liquid metal alloy in propane dehydrogenation and hydrogenation as well as the new design of bimetallic or multimetallic alloy nanoparticales fabrication method.*

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