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# Low Pressure Ammonia Synthesis Using Ga-based Liquid Metal Catalysts

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## ABSTRACT

*Ammonia synthesis by conventional Haber–Bosch process has made significant contribution to the sustainability of agriculture. The process, as it stands, requires specific catalysts (Fe and Ru) to function effectively and elevated temperature and pressure (typically, 350–550 °C and 15–35 MPa). Merging this process with renewable energy sources requires improved catalytic materials with good ammonia conversion rates at lower operating conditions. Liquid metals offer unique catalytic properties stemming from their high enthalpy and entropy in liquid state. Moreover, their properties can be tailored for specific applications (for example, enhanced catalytic activity) by incorporating small amounts of transition and noble metals . It has been proposed that synergistic effects and robustness of liquid metals can help overcome the limitations of traditional Haber–Bosch catalysts.While research has explored simple Ga and Ga–In alloy catalysts for electrochemical and plasma-assisted ammonia synthesis, the full potential of thermocatalytic ammonia synthesis using liquid metals remains largely unexplored. In search for advanced catalysts, we developed a Cu–Ga catalyst for ammonia synthesis. When compared with commercial Ru- and Fe-based catalysts, Cu–Ga catalyst shows good activity at low pressure of 0.4 MPa.*

## KEY WORDS

*Liquid metal, ammonia synthesis, catalysis*

## BIOGRAPHY

Saba got her bachelor's in Chemical Engineering from the University of Engineeering and Technology, Lahore, Pakistan in 2018. She finished at the top of her class and was awarded with a gold medal for outstanding academic acheivement. She completed her master's in Chemical Engineering from Universiti Teknologi PETRONAS, Malaysia, in 2022, where she developed activated porous carbon from rubber-seed shells for $CO_2$ adsorption. She joined RMIT as a PhD candidate in 2022 and is working on synthesizing supported and unsupported liquid metal catalytic systems for ammonia synthesis. She has experience in material development and characterization using advanced techniques including TEM, TGA, and GC/MS. .

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