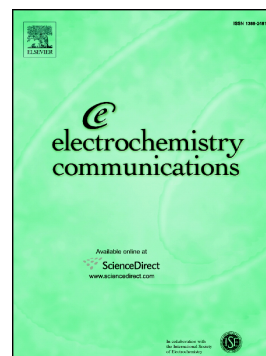


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# Electrochemical synthesis of ammonia using ruthenium–platinum alloy at ambient pressure and low temperature

Revanasiddappa Manjunatha and Alex Schechter\*

Department of Chemical Sciences, Ariel University  
Ariel Research Park, Ariel, Israel 40700

## Abstract

Ammonia was electrochemically produced from nitrogen and water using a ruthenium–platinum (RuPt) alloy catalyst cathode and a nickel anode at ambient pressure and room temperature. The rate of ammonia formation was  $5.1 \times 10^{-9} \text{ g}_{\text{NH}_3} \text{ s}^{-1} \text{ cm}^{-2}$  with a 13.2% faradaic efficiency at an applied potential of 0.123 V vs. RHE; it reached  $1.08 \times 10^{-8} \text{ g}_{\text{NH}_3} \text{ s}^{-1} \text{ cm}^{-2}$  at 0.023 V. Ammonia production was investigated under selected potentials and temperatures. Real-time direct electrochemical mass spectrometric (DEMS) analysis of the evolved gases was performed at various applied potentials. In general, the mass-to-charge ratio signals of hydrogen and ammonia were detected, and their intensities increased with increasing potentials; however, there was no trace of a hydrazine signal. Compared to metallic ruthenium and platinum catalysts, RuPt showed a synergistic effect toward electrochemical formation of ammonia due to co-catalysis.

**Key words:** Electrocatalysis, Nitrogen Reduction, Ruthenium-Platinum, Alloy,  
Ammonia, production

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Corresponding author\*

Tel.: +972 39371470; fax : +972 547740254

Email : salex@ariel.ac.il

## 1. Introduction

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