New sustainable way to synthesize vital fertilizer

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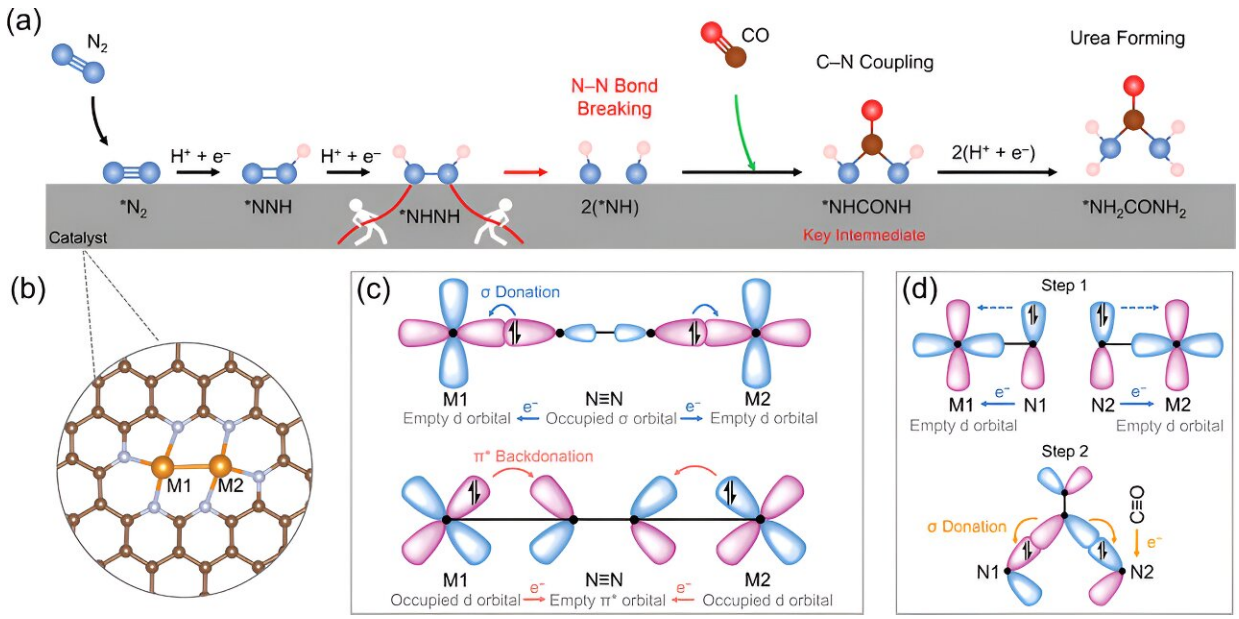

a) Schematic diagram showing the proposed mechanism for C—N coupling induced by the N—N bond rupture during the urea electrosynthesis process; b) the desired structure of M_1M_2 dual metal sites; simplified schematic diagram of c) N_2 bonding to dual-metal sites and (d) C—N coupling for *NHCONH formation based on the N—N bond rupture. Credit: *Advanced Functional Materials* (2023). DOI: 10.1002/adfm.202305894

QUT scientists have discovered how to produce the vital agricultural fertilizer urea at room temperature without the large energy input of the traditional production process of synthetic urea.

Dr. Junxian Liu, first author on the study, worked with with co-researchers Professor Yuantong Gu and Associate Professor Liangzhi Kou from the School of Mechanical, Medical and Process Engineering. Their study, "C–N Coupling Enabled by N–N Bond Breaking for Electrochemical Urea Production," was published in *Advanced Functional Materials*.

Dr. Liu said urea is one of the most vital nitrogen fertilizers and supported about 27% of the world's crops.

"Urea is also a basic raw material for manufacturing industries including pharmaceuticals, cosmetic and plastic," Dr. Liu said.

"While urea does occur naturally in the environment it is not sufficient to meet the global demand due to population growth and the expansion of agriculture and these various industries.

"The industrial production of synthetic urea began in the early 20th century and the traditional process involves the reaction of ammonia and carbon dioxide at very high temperatures and high pressure."

Dr. Liu said the team proposed a new solution for synthesizing urea using a chemical reaction between nitrogen and carbon monoxide with a graphene-based catalyst under room temperature and atmospheric pressure conditions.

"This approach significantly reduces energy inputs compared to traditional methods, making it a promising advancement in urea production," she said.

"While this work is in the theoretical stage, we have identified a promising catalyst for sustainable, energy efficient urea synthesis.

"We are now collaborating with other research groups to move towards practical application of this new technology."

More information: Junxian Liu et al, C—N Coupling Enabled by N—N Bond Breaking for Electrochemical Urea Production, *Advanced Functional Materials* (2023). DOI: 10.1002/adfm.202305894

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