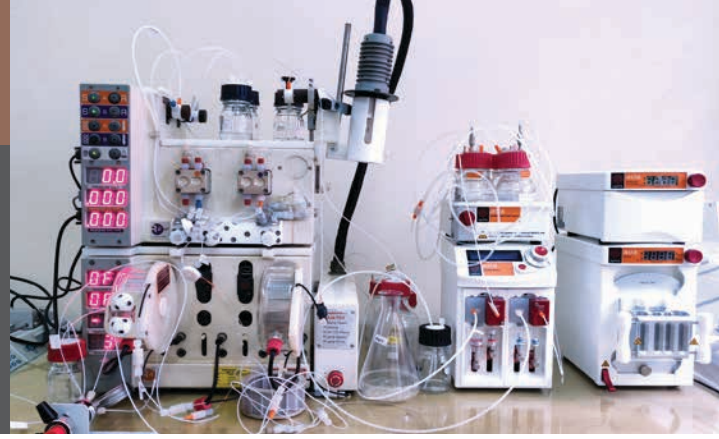
Scalable High Energy Materials (HEM) Synthesis



Problem Statement: High Energetic Materials (HEM) synthesis is difficult to scale up in batch due to their high reactivity. They are generally sensitive to heat, mechanical shock, and spark. They can explode during their synthesis if prepared on a bulk scale. The general batch synthetic procedures are of longer duration and a mixture of product forms. Currently, defence and other organisations in India do not synthesise high nitrogen energetic materials using continuous flow. The researchers have proposed a continuous flow methodology to address this requirement and produce different high nitrogen energetic materials on a bulk scale in a safer manner, which will strengthen the indigenous defence capability.

Uniqueness of the Solution: The researchers have developed a methodology using continuous flow reactors, where the reaction will occur in micro-channels providing better heat and mass transfer among the molecules giving a short reaction time. It can support on-demand production. Fully optimised flow reactor methodology is used to scale up and prepare the high nitrogen compounds on a kilogram scale, unlike batch processes. The use of tabletop models can replace the bigger asset requirements, thus reducing the plant footprint.

Current Status of Technology: The researchers have designed a prototype assembling flow reactors and successfully synthesising high nitrogen-containing molecules such as 2,4-dinitroanisole (DNAN, secondary explosive) and cyanuric triazide (CTA, Primary explosive). Both of these molecules can be produced in gram to kilogram scale in a safer manner under industry-relevant conditions.

Societal Impact: The proposed methodology eliminates hazards and increases process safety. This technology can be utilised by DRDO, ISRO, Naval Research, Premier Explosive Limited, Economic Explosive Limited and other defence-related organisations to strengthen our national security.

Patent(s): Under progress

Relevant Industries: Defence, Aerospace, Energy, Chemicals.

Faculty: Prof. Debabrata Maiti and Prof. Arnab Dutta, Chemistry.