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**Project Title:** Development of Space Chemical Synthesis for NASA Space Exploration Missions

**Project Summary:** The goal of this research is to develop photochemical flow reactions for the in-space synthesis of essential materials, with a particular focus on flame retardants (FRs). As human spaceflight extends beyond Low Earth Orbit (LEO), the significance of In-Space Manufacturing (ISM) becomes increasingly evident. Prolonged missions increase the risks associated with continuous logistics resupply from Earth, underscoring the critical need for ISM of vital materials. In addition, conventional magnetic-stirring chemical reactions face significant challenges in the absence or reduced gravity of space. To address this challenge, we propose the development of a photochemical flow reaction method suitable for in-space synthesis applications. The primary application of this photochemical flow reaction will be for the synthesis of FRs, crucial materials for safeguarding astronauts, equipment, and space habitats from fire hazards. It can also be applied to the synthesis of medicinal compounds such as triazole- and disulfide-containing compounds in space. To achieve ISM for essential materials such as non-halogenated FRs and medicinal intermediates, we will develop sustainable photochemical flow reactions. These reactions will be utilized to synthesize phosphate, triazole, and disulfide functional groups for FRs, known as fire-suppressing motifs.