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INFORMATION ON THE NOVEL CONTRIBUTIONS OF THE DOCTORAL DISSERTATION

Dissertation title: *"Synthesis of zinc borate, aluminum hydroxide, and hydrotalcite in nano-plate form for application in the fabrication of flame-retardant polymer composites"*

Field of study: Chemical Engineering Code: 9520301

Doctoral candidate: Truong Cong Doanh Course: .....

Supervisors:

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Training institution: Hanoi University of Industry

NOVEL CONTRIBUTIONS OF THE DISSERTATION

1) Zinc borate nanosheets (nZB) with high hydrophobicity were successfully synthesized by using oleic acid as a surfactant during the synthesis process. The study clearly elucidated a pronounced synergistic effect among nZB, expanded graphite (EG), and red phosphorus (RP) in polypropylene (PP)-based polymer composites. Nanocomposites containing nZB exhibited superior flame retardancy and mechanical properties compared with materials incorporating commercial micrometer-sized zinc borate.

2) Aluminum hydroxide nanosheets (nATH) were successfully synthesized via a hydrothermal method and surface-modified with polyethyleneimine (PEI) to obtain $nATH_{PEI}$, which shows excellent dispersion in an epoxy (EP) matrix. The dissertation demonstrated an optimal synergistic effect between $nATH_{PEI}$ and APP@PEI. Epoxy composites containing these additives achieved UL-94 V-0 flame-retardant classification and an LOI value of 31.1%, along with a significant improvement in mechanical properties. The flame-retardant mechanism was clarified based on the formation of a thermally stable aluminum phosphate phase in the protective char layer.

3) The DOPO-HT nanohybrid (DOPO-intercalated Mg/Al hydrotalcite) was synthesized and applied as a synergistic flame retardant for epoxy resin. The study identified that at an optimal DOPO/HT ratio of 3/1, the DOPO-HT hybrid exhibits the strongest synergistic effect with APP@PEI. Epoxy composites containing these additives achieved UL-94 V-0 classification, an LOI value of 32%, and a pronounced enhancement in mechanical properties.