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### Flame retardants nanocomposites: Synergy effect of combining conventional antypirenes with carbon nanofillers

The thermoset resins are proven construction materials for the technical and highly demanding applications. Heat stability, high thermal, low shrinkage, mechanical properties are typical for their type of polymers. Above applications also requires a good flame retardant (FR). Undertaken activities refer to official draft recommendations in UE states. This paper presents positive effect of reduced flammability of thermoset resins thanks to the use of nanocomposites containing multi-ingredient halogen-free flame retardants which combine phosphorus/nitrogen modifiers interacting with nanofillers: Expandable graphite (EG), graphene (G), graphene oxide (GO) and anthracite (AN). The flame retardancy of modified polymers has been investigated by LOI analysis, TG and by using CC method. The fine-plates, phase morphology of nanocomposites were assessed by SEM. We confirm that nanocomposite formation is an important concept for the flame retardants industry. Laminates made of modified resins meet requirement LOI over 28-34% and reduced 30-70% head release rate (HRR) by CC method. No adverse impact on strength properties was observed. A multi-ingredient combination of FR turned out to make significant progress in achieving a desired flammability. It should be assumed that the presence of conventional flame retardants led to a synergy effect promoting faster formation of a protection layer hindering oxygen flow-through resulting from the process of thermal destruction.

### Biography

Ewa Kicko Walczak graduated from Polytechnic University in Warsaw, Chemical Department. In 1979, she started working in Industrial Chemistry Research Institute. In 1985, she was recipient of Doctor Technical Science title from ICHRI; and in 2012, she received a DSc Chemistry Faculty of Cracow University. Since 2010, she started to cooperate with The Institute for Engineering of Polymers Materials and Dyes (IIMPd) and since 2015 is General Director of IIMPd. She completed International Centre of Physics and Chemistry in Ferrara-Roma (Italy) and International Professional Course for Managers of Chemical and Pharmaceutical Industry in Copenhagen (Denmark)-Washington (US). She is the author of more than 80 original research publications and author 90 scientific presentations in international conferences. She is also author (or co-author) of 65 patents/patent applications. She has coordinated Polish and international conferences, 23 research projects oriented towards new polymer materials. Her scientific activity concentrates on ecological aspect of technology and modification polymeric materials, particularly on fire retardant and reduced smoke toxic emission from thermoset resins systems.

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