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## Flame-Retardant, Non-Irritating and Self-healing Multilayer Films with Double-Network Structure

Hongyun Xuan<sup>a</sup>, Jiaoyu Ren<sup>a</sup>, Xizhang Wang<sup>b</sup>, Jianhao Zhang<sup>c</sup>, Liqin Ge<sup>a,\*</sup>

<sup>a</sup>State Key Laboratory of Bioelectronics, School of Biological Science and Medical Engineering, Southeast University, Nanjing 210096, P.R. China

<sup>b</sup>Nanjing university, Nanjing 210096,P.R.China.

<sup>c</sup>Nanjing Center of Meat Quality and Safety Control, Key Lab of Meat Processing and Quality Control, Ministry of Education, College of Food Science, Nanjing agricultural university, Nanjing 210096,P.R.China.

\* E-mail: [lqge@seu.edu.cn](mailto:lqge@seu.edu.cn).

**Abstract:** Flame-retardant, non-irritating, and self-healing double-network films based on host–guest interaction were prepared on paper via layer-by-layer (LbL) assembly. The multilayer films are composed of poly (acrylic acid)-adamantanamine / ammonium polyphosphate-cross-poly (ethylenimine)- $\beta$ -cyclodextrin (PAA-AD/APP-co-PEI- $\beta$ -CD). After a mild reaction between APP and PEI- $\beta$ -CD polymers, PAA-AD and APP-co-PEI- $\beta$ -CD polymers form the novel double-network films via the host–guest interaction. The novel film can produce a self-healing surface without any initiating agents. Besides, when directly exposed to a flame, such films will generate foam char layers because of the intumescent effect, and will endow the print paper with a self-extinguishing property. The fire protection of the coatings was intensively investigated by a fire protection test, scanning electron microscopy (SEM), compressive strength test, thermogravimetric analysis (TGA), and real-time Fourier

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