Layer by Layer Assembly:
A Current Emerging Technique for Conferring Flame Retardancy

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Abstract
Layer by Layer (LbL) assembly consists in a step-by-step film build-up based on electrostatic interactions; it was introduced in 1991 for polyanion/polycation couples in order to obtain the so-called polyelectrolyte multilayers [1], and subsequently extended to inorganic nanoparticles [2] exploiting different interactions (e.g. covalent bonds, hydrogen bonds, etc.) beside the electrostatic one. The LbL assembly through electrostatic interactions simply requires the alternate immersion of the substrate into an oppositely charged polyelectrolyte (usually water-based) solution (or dispersion). Thus, an assembly of positively and negatively charged layers piled up on the substrate surface is obtained, exploiting a total surface charge reversal after each immersion step. LbL was first described in 1966 [3] and has been rediscovered and optimized decades later [4, 5]. Very recently, such approach proved to be extremely advantageous when exploited for the flame retardancy of foams [6, 7], thin and thick films [8-10], fibres and fabrics [11-13]. More specifically, different types of architectures have been deposited on fabrics: namely, i) i*norganic LbL coatings;* ii) *hybrid organic-inorganic or intumescent LbL coatings;* and iii) *char-former/enhancer LbL coatings*. The main results collected in the literature will be described in the present work, with particular attention to the possible industrial exploitations. Indeed, although dipping has been widely investigated as deposition technique, surprising results have been obtained employing spray, as well. A deep overview of all these results will be presented.

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