We employed a mussel-inspired polymer, poly(dopamine), and carried out extensive investigation of its biological in vitro effects as a coating capable of direct physicochemical cueing to adhering cells. Our results show that human derived osteoblastic cells showed a differential activity on samples coated with a thin layer of poly(dopamine). Fluorescence microscopy permitted to correlate cell structure to the physicochemical features of surfaces, characterized by spectroscopic techniques (Raman and FTIR) and Atomic Force microscopy (AFM). These techniques allowed us to precisely probe the chemical makeup of the surfaces, confirming the presence of a homogeneous PDA layer, as well as their nanotopography, characterized by a granular texture. In addition, the capacity of retaining proteins onto surfaces, a factor that can contribute to explain the observed cellular results, was assessed by infrared and mass spectroscopy. Such correlation was fundamental to unveil the cellular mechanisms underlying the observed variations of cell response, and promise to become a fundamental prerequisite for future studies that aim at extending the breath of poly(dopamine) to other applications in bone tissue engineering. In addition, confocal imaging allowed us to investigate the formation and maturation of focal adhesions at the short term. Finally, PCR assays were exploited to close in on gene and protein profiling, to correlate cell adhesion, formation of focal adhesion and protein expression.

**Keywords:** bio-inspired surface, In vitro response, Cell-surface interactions

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