Adhesion improvement of conductive poly-lactic acid filament 3D printed onto polyethylene terephthalate fabric through chemical bonding

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Abstract:

Adhesion of conductive poly-lactic acid filament (PLA) 3D printed onto polyethylene terephthalate (PET) fabrics is a one of the fundamental properties to guarantee their use in smart textiles field. The conductive PLA layer is made of carbon black (CB) incorporated into PLA polymer prior to extrusion process. It is commonly known that due to the low surface tensions of polymeric materials, 3D printed conductive PLA onto PET textiles possess poor adhesion. Therefore, an improvement of this property, even already approached by some researchers (1–6), is still highly required. In this research work, a pre and post-treatments were applied to significantly improve the adhesion strength at the interface polymeric layer/textile compared to former techniques used in other researches such as plasma treatment; coating of glue stick, washing and ironing processes. The pre-treatment consists in grafting acetic acid by UV curing onto both PET fabric and PLA filament through digital printing and deep coating respectively and then applying a solution pressure sensitive adhesive (PSA) on the fabric via digital printing. After 3D printing process on textiles, heat and pressure were applied on the materials using a heat press to chemically bond the PLA layer to the PET fabric. The findings are very promising as they demonstrate the possibility of significantly improving the adhesion of thermoplastic polymer 3D printed on textiles for smart textiles applications. Compared to other alternative solutions, these findings can potentially be implemented, in the future, by using 3D printing technology for pre-treatment and printing processes followed by thermo-compression technique for complete chemical bonding.