EUPOC 2017 on POLYMERS AND ADDITIVE MANUFACTURING: FROM FUNDAMENTALS TO APPLICATIONS
GARGNANO – LAKE GARDA (ITALY), 21-25 MAY, 2017

3d Printing Filaments: Characterization Of A New Class Of Composite Materials

DAFNE CIMINO[1], GIULIA ROLLO[2], MARCO ZANETTI[1], PIERANGIOLA BRACCO[1]~~, DAFNE CIMINO[1], GIULIA ROLLO[2],~~

[1]Department of Chemistry, University of Turin, via Pietro Giuria 7, 10125 Torino (Italy)
Email: xxx@unito.it
[2] Koinè?

Abstract

3D modelling and printing techniques are spreading in daily life as solutions or implementations of objects production. Among the advantages that these technologies have brought in industrial and niche sectors, the possibility -to create, from a digital design, specific solid models ~~and this~~ is at the base of the popular employment in prototyping[1],[2]. Moreover, there are fields such as ~~–~~biomedical and conservation of cultural heritage, where the printing of unique objects ~~that should be placed in "subjects" that are unique at the same way~~ is a peculiarity. Reconstructing a fragmented artifact is a complex and time-consuming process and the use of low-cost techniques of 3D printing for the restoration of missing parts in cultural heritage preservation can be a strong improvement. However, ~~In particular, in the latter sector, aspects as~~ long-term-durability at environmental conditions ~~(indoor or outdoor environments)~~, compatibility with the ~~object~~artefact and reversibility are significant~~, therefore mechanical characterization only is not enough~~[3].
~~One of the most common 3D printing methods is f~~Fused ~~filament fabrication~~deposition modelling (~~FFF~~FDM)[4], is an additive manufacturing technology that builds parts up layer-by-layer by heating and extruding thermoplastic filament[5]~~where the printing process uses a continuous filament of a thermoplastic material~~s. ~~It allows to create a single specific piece,~~
~~characteristic why biomedical and conservation fields are taking advantages of these new solutions: printed objects are unique and placed in "subjects" that are unique in the same way. In particular, in the latter sector, aspects as long-term-durability at environmental conditions (indoor or outdoor environments), compatibility with the object and reversibility are significant, therefore mechanical characterization only is not enough [Capetta,.~~ Filaments are based on thermoplastic polymers~~ of different chemical nature~~, sometimes enhanced with fillers in order to obtain particular colours or materials effects (e.g. being similar to wood or metal) more than improved mechanical properties. Even though they are composite materials and this change has an effect on their workability and lifetime, ~~aspects~~ not often taken into consideration by artisans and producers~~, both~~.
~~Therefore, p~~Several filaments have been characterized for evaluating the influence of filler addition and changes eventually induced during the printing step, from chemical modifications to VOCs release. ~~In particular~~In particular, FTIR-ATR, TGA, DSC, Py- and SPME-GC/MS together with mechanical tests have been carried out on original, printed and aged materials. Data have then been compared with specifications supplied by the producers, i.e. printing suggestions and material performances, often without considering work-conditions, neither indicating if suitable for external environment.

---

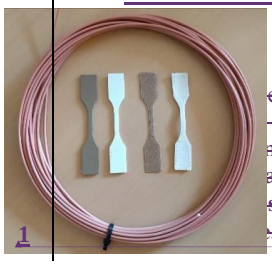
[1] Boparai K.S., Singh R., Singh H.. Rapid prototyping journal, 22/2 (2016) 281-299
[2] Lipson et al.. Journal of mechanical design, 127 (2005) 1029-1033
[3] Braghieri et al.. Oral presentation. Daily seminar "Il restauro nell'era della fabbricazione digitale", Parma, Italy (2016)
~~[4] Turner B.N., Gold S.A.. Rapid prototyping journal, 21/3 (2015) 250-261~~
[5] Turner B.N., Gold S.A.. Rapid prototyping journal, 21/3 (2015) 250-261

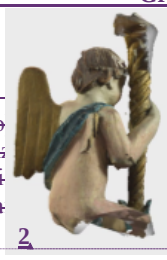
Commentato [DC1]: A voi la scelta di ordine, chi presenta, chi mettere
Commentato [DC2]: A voi la scelta di ordine, chi presenta, chi mettere
Commentato [DC3]: A voi la scelta di ordine, chi presenta, chi mettere
Formattato: Apice
Commentato [DC4]: A voi la scelta di ordine, chi presenta, chi mettere
Formattato: Nessuna
Formattato: Inglese (Stati Uniti)
Formattato: Inglese (Stati Uniti)
Commentato [DC5]: or improving
Commentato [DC6]: 11, ma non tutti in tutti gli aspetti e in attesa di nuovi provini
Commentato [DC7]:
Formattato: Inglese (Stati Uniti)
Formattato: Tipo di carattere: 10 pt, Inglese (Stati Uniti)
Formattato: Inglese (Stati Uniti)
Formattato: Inglese (Stati Uniti)
Formattato: Tipo di carattere: 10 pt, Inglese (Stati Uniti)
Formattato: Tipo di carattere: 10 pt
Formattato: Tipo di carattere: 10 pt, Inglese (Stati Uniti), Non Apice / Pedice
Formattato: Inglese (Stati Uniti)
Formattato: Tipo di carattere: 10 pt, Inglese (Stati Uniti)
Formattato: Tipo di carattere: 10 pt
Formattato: Tipo di carattere: 10 pt, Inglese (Stati Uniti), Non Apice / Pedice
Formattato: Inglese (Stati Uniti), Non Apice / Pedice
Formattato: Inglese (Stati Uniti)
Formattato: Tipo di carattere: 10 pt, Non Apice / Pedice
Formattato: Tipo di carattere: 10 pt
Formattato: Tipo di carattere: 10 pt
Formattato: Tipo di carattere: 10 pt, Inglese (Stati Uniti), Non Apice / Pedice
Formattato: Inglese (Stati Uniti), Non Apice / Pedice
Formattato: Italiano (Italia), Non Apice / Pedice
Formattato: Tipo di carattere: 10 pt

The clue of a limited characterization of the commercial materials has risen observing how some filaments are heated up to temperature higher than their offset temperature of degradation. In other cases, a chemical modification has been detected just leaving the unprinted material in a drawer in laboratory environment conditions.

~~This poster~~This work aims ~~at~~ to introducing the most peculiar results of this research, underlining materials weaknesses.

Graphical abstract





1: filament for FFF printing technique and ~~dog-bone shape~~ speciments for mechanical characterization.

2: wooden sculpter, cherub with a missing wing.

3: 3D printed wing to be placed on the sculpture before and after finishing.

~~eri (3D~~
~~Torino~~
~~atenden~~
~~aso Poli~~
~~**stampa**~~
~~**.**~~

~~orino) Dante Cimino~~
~~es. Luigino) Vittoria~~
~~itta metropolitana di~~
~~, Torino)~~
~~**nel restauro di due**~~

Formattato: Giustificato, Tabulazioni: 8 cm, Allineato al centro + 13,02 cm, Allineato a sinistra + 13,36 cm, Allineato a sinistra

Formattato: Inglese (Stati Uniti)

Formattato: Inglese (Stati Uniti)

Formattato: Inglese (Stati Uniti)

Formattato: Tipo di carattere: Times New Roman, 10 pt, Inglese (Stati Uniti)

Formattato: Tipo di carattere: Times New Roman, Grassetto

Formattato: Tipo di carattere: Times New Roman, Grassetto

Formattato: Tipo di carattere: Times New Roman, Grassetto

Formattato: Tipo di carattere: Times New Roman, Grassetto