

## **Antonio Mattia Grande**

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### **Carriera accademica**

- *Settembre 2017 – a oggi.* Ricercatore (RTDa) presso il Dipartimento di Scienze e Tecnologie Aerospaziali, Politecnico di Milano
- *Luglio 2013 – Luglio 2016.* Ricercatore post dottorato presso il Dipartimento di Ingegneria Aerospaziale, Delft University of Technology (TU Delft); gruppo Novel Aerospace Materials (NovAM)
- *Marzo 2014.* Conseguimento del Dottorato di Ricerca in Ingegneria Aerospaziale, con merito, presso il Politecnico di Milano. Titolo della tesi: "Self-healing ionomer based systems for aerospace applications"
- *Settembre 2012 – Giugno 2013.* Periodo di ricerca presso il Dipartimento di Ingegneria Aerospaziale, Delft University of Technology (TU Delft), in collaborazione con il Prof. S. van der Zwaag, gruppo Novel Aerospace Materials (NovAM)
- *Gennaio 2011.* Ammissione al dottorato di ricerca in Ingegneria Aerospaziale presso il Politecnico di Milano e assegnazione di borsa di studio ministeriale
- *Ottobre 2009.* Laurea specialistica in Ingegneria dei Materiali, conseguita presso il Politecnico di Milano. Titolo della tesi: "Modellazione numerica e ottimizzazione del processo VaRTM"
- *Marzo 2007.* Laurea in Ingegneria Aerospaziale, conseguita presso il Politecnico di Milano. Titolo della tesi: "Analisi dinamica: metodologie e approssimazioni"

### **Attività scientifica**

#### *Interessi di ricerca*

Materiali e tecnologie aerospaziali, materiali multifunzionali, materiali auto-riparanti, meccanica della frattura, tecnologie di processo di materiali compositi, strutture ibride e multistrato, additive manufacturing

#### *Partecipazione a progetti di ricerca*

- ASI-Politecnico di Milano research agreement, "Design of new smart material for space applications", accordo quadro n. 2016-27-H.0
- AMATHO, Additive MANufacturing for Tiltrotor HOusing (grant Agreement number 717194, <https://www.amatho.org>)
- Progetto SHINE (European Seventh Framework NMP Program, grant agreement 309450-2, <http://www.selfhealingelastomers.eu>), presso TU Delft
- Dutch National IOP program on self-healing materials (grant IOP-SHM-1028), presso TU Delft
- Progetto STIMA, Strutture Ibride per la Meccanica e l'Aerospazio (<http://www.progettostima.it>), presso Politecnico di Milano

- Progetto PRIN 08 "Nanoibridi inorganici a base di bio-poliesteri da risorse rinnovabili" (Prin 08 - 200898KCKY), presso Politecnico di Milano

#### *Seminari su invito*

- Titolo "Towards Self-Healing Polymers for Aerospace Applications: Experimental Tools to Evaluate Healing Capability", Self-Healing Polymers, AMI Conference, Londra, 8-9 ottobre 2018
- Titolo "Self-healing polymers and composites", presso Univeristy of Twente, Enschede, Paesi Bassi, 17 giugno 2016
- Titolo "How well does it heal? Fracture mechanics as useful tool to evaluate the healing capability of novel polymers", presso l'École supérieur de physique et de chimie industrielles de la Ville de Paris (ESPCI), Parigi, Francia, 18 novembre 2015

#### *Organizzazione di conferenze internazionali*

- Invited co-organizer of the "Elastomer Materials and Processing" symposium in the 30<sup>th</sup> Polymer Processing Society Conference (Cleveland, Ohio, Jun. 2014)

#### *Memberships*

- AIDAA, Associazione Italiana di Aeronautica e Astronautica (2017 - a oggi)
- Polymer Processing Society (2013 - 2015)

### **Attività didattica**

#### *Incarichi di insegnamento*

Lezioni, esercitazioni e attività di laboratorio svolte regolarmente dal 2011 al 2016 nei corsi:

<b>Corso (ruolo)</b>	<b>Università</b>	<b>Periodo (dal – al)</b>
Tecnologie e materiali aerospaziali (docente)	Politecnico di Milano	09/17 – a oggi
Aerospace technologies and materials (lecturer)	Politecnico di Milano	09/17 – a oggi
Materials Characterization (tutor)	Delft University of Technology	05/16 – 06/16
Design of Self-Healing Materials (lecturer and tutor)	Delft University of Technology	02/15 – 02/16
Design Synthesis (tutor)	Delft University of Technology	11/13 – 06/15
Tecnologie e materiali aerospaziali (seminarista ed esercitatore)	Politecnico di Milano	04/11 – 07/13

#### *Attività di supervisione*

Relatore e correlatore di 15 tesi di Laurea Specialistica, Master of Science (MSc) discusse al Politecnico di Milano (PoliMi), Delft University of Technology (TU Delft) e altre università straniere.

<b>Anno</b>	<b>Titolo</b>	<b>Studente</b>	<b>Università</b>
2018	Characterization of a dynamic epoxy network: curing and functional properties	Stefano Paolillo	PoliMi
2018	Static and Fatigue Characterization of Ti-6Al-4V Manufactured by Electron Beam Melting	Onur Utku Uçak	PoliMi

2017	Selective Laser Melting of A357 aluminium alloy: effect of heat treatments on microstructure and mechanical properties	Anna Lombardi	poliMi
2015	Investigating the effect of time, temperature and damage cycles on the healing of novel elastomers	Shail Boda	Imperial College / TU Delft
2014	Quantification of the self-healing behaviour of a supramolecular elastomer by means of a peel testing procedure	Manuel Morais	University of Lisbon / TU Delft
2014	Experimental characterization of mechanical properties and self healing behavior of supramolecular elastomer filled with aramid fibers	Carolina De Stasio	TU Delft / PoliMi
2013	Ballistic response of self healing multilayers with ionomer and epoxidized natural rubber	Laura Bertoli	PoliMi
2013	Studio sperimentale e numerico della delaminazione in materiali compositi realizzati con tecnologia RTM	Alex Vitali	PoliMi
2013	Comportamento balistico di strutture multistrato sandwich contenenti ionomeri autoriparanti	Emanuele Fedele	PoliMi
2012	Analisi di materiali compositi biocompatibili prodotti con tecnologia RTM	Alessandra Lombardi	PoliMi
2012	Comportamento autoriparante di un polimero ionomerico e delle sue miscele con gomma naturale ed epossidata	Valerio Volpato	PoliMi
2012	Caratterizzazione e analisi sperimentale del comportamento balistico di polimeri ionomerici autoriparanti	Ivan Quadrio, Stefano Zaffaroni	PoliMi
2012	Caratterizzazione di un polimero ionomerico autoriparante per applicazioni spaziali	Luca Castelnovo	PoliMi
2011	Analisi sperimentale del comportamento di un polimero autoriparante e sviluppo preliminare di un modello viscoelastico	Sara Coppi	PoliMi
2011	Caratterizzazione di biocompositi a matrice polimerica e nanofibre di cellulosa	Aida Curci	PoliMi

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### Elenco delle pubblicazioni

#### *Articoli su riviste internazionali*

- 1) Grande AM, Bijleveld JC, Garcia SJ, van der Zwaag S (2016). A combined fracture mechanical - rheological study to separate the contributions of hydrogen bonds and disulphide linkages to the healing of poly(urea-urethane) networks. *POLYMER*, vol. 96, p. 26-34, ISSN: 1873-2291, doi:10.1016/j.polymer.2016.05.004
- 2) Susa A, Bose RK, Grande AM, van der Zwaag S, Garcia SJ (2016). Effect of the dianhydride/branched diamine ratio on the architecture and room temperature healing behavior of polyetherimides. *ACS APPLIED MATERIALS & INTERFACES*, vol. 8, p. 34068-34079, ISSN: 1944-8244, doi:10.1021/acsami.6b10433
- 3) Hernandez M, Grande AM, van der Zwaag S, Garcia SJ (2016). Monitoring Network and Interfacial Healing Processes by Broadband Dielectric Spectroscopy: A Case Study on Natural Rubber. *ACS APPLIED MATERIALS & INTERFACES*, vol. 8, p. 10647-10656, ISSN: 1944-8244, doi:10.1021/acsami.6b02259
- 4) Abdolah Zadeh M, Grande A, Van Der Zwaag S, Garcia SJ (2016). Effect of curing on the mechanical and healing behaviour of a hybrid dual network: A time resolved evaluation. *RSC ADVANCES*, vol. 6, p. 91806-91814, ISSN: 2046-2069, doi:10.1039/C6RA17799A
- 5) Hernandez, M, Grande AM, Dierkes W, Bijleveld J, Van Der Zwaag S, Garcia SJ (2016). Turning Vulcanized Natural Rubber into a Self-Healing Polymer: Effect of the Disulfide/Polysulfide Ratio. *ACS SUSTAINABLE CHEMISTRY & ENGINEERING*, vol. 4, p. 5776-5784, ISSN: 2168-0485, doi:10.1021/acssuschemeng.6b01760
- 6) Khaliq J, Li CC, Chen K, Shi BG, Ye HT, Grande AM, Yan HX, Reece MJ (2015). Reduced thermal conductivity by nanoscale intergrowths in perovskite like layered structure La<sub>2</sub>Ti<sub>2</sub>O<sub>7</sub>. *JOURNAL OF APPLIED PHYSICS*, vol. 117, ISSN: 0021-8979, doi:10.1063/1.4908209
- 7) Grande AM, Garcia SJ, van der Zwaag S (2015). On the interfacial healing of a supramolecular elastomer. *POLYMER*, vol. 56, p. 435-442, ISSN: 0032-3861, doi:10.1016/j.polymer.2014.11.052
- 8) Vega JM, Grande AM, van der Zwaag S, Garcia SJ (2014). On the role of free carboxylic groups and cluster conformation on the surface scratch healing behaviour of ionomers. *EUROPEAN POLYMER JOURNAL*, vol. 57, p. 121-126, ISSN: 0014-3057, doi:10.1016/j.eurpolymj.2014.05.005
- 9) van der Zwaag S, Grande AM, Post W, Garcia SJ, Bor TC (2014). Review of current strategies to induce self-healing behaviour in fibre reinforced polymer

based composites. MATERIALS SCIENCE AND TECHNOLOGY, vol. 30, p. 1633-1641, ISSN: 0267-0836, doi:10.1179/1743284714Y.0000000624

- 10) Janszen G, Grande AM, Bettini P, Di Landro L (2014). Integrated solutions for safe fuel tanks. INTERNATIONAL JOURNAL OF SAFETY AND SECURITY ENGINEERING, vol. 4, p. 271-279, ISSN: 20419031, doi:10.2495/SAFE-V4-N3-271-279
- 11) Francesconi A, Giacomuzzo C, Grande AM, Mudric T, Zaccariotto M, Etemadi E, Di Landro L, Galvanetto U (2013). Comparison of Self-Healing Ionomer to Aluminium-Alloy Bumpers for Protecting Spacecraft Equipment from Space Debris Impacts. ADVANCES IN SPACE RESEARCH, vol. 51, p. 930-940, ISSN: 0273-1177, doi:10.1016/j.asr.2012.10.013
- 12) Rahman MA, G. Spagnoli, A.M. Grande, L. Di Landro (2013). Role of Phase Morphology on the Damage Initiated Self-Healing Behavior of Ionomer Blends. MACROMOLECULAR MATERIALS AND ENGINEERING, vol. 298, p. 1350-1364, ISSN: 1438-7492, doi:10.1002/mame.201200399
- 13) Grande AM, L. Castelnovo, L. Di Landro, C. Giacomuzzo, A. Francesconi, M.A. Rahman (2013). Rate-Dependent Self-Healing Behavior of an Ethylene-Co-Methacrylic Acid Ionomer under High-Energy Impact Conditions. JOURNAL OF APPLIED POLYMER SCIENCE, vol. 130, p. 1949-1958, ISSN: 0021-8995, doi:10.1002/app.39384
- 14) Rahman MA, M. Penco, G. Spagnoli, A.M. Grande, L. Di Landro (2011). Self-Healing Behavior of Blends Based on Ionomers with Ethylene/Vinyl Alcohol. MACROMOLECULAR MATERIALS AND ENGINEERING, vol. 296, p. 1119-1127, ISSN: 1438-7492, doi:10.1002/mame.201100056
- 15) Rahman MA, M. Penco, I. Peroni, G. Ramorino, A.M. Grande, L. Di Landro (2011). Self-Repairing Systems Based on Ionomers and Epoxidized Natural Rubber Blends. ACS APPLIED MATERIALS & INTERFACES, vol. 3, p. 4865-4874, ISSN: 1944-8244, doi:10.1021/am201417h

#### *Capitoli di libri*

- 1) Bode S, Enke M, Hernandez M, Bose RK, Grande AM, van der Zwaag S, Schubert US, Garcia SJ, Hager MD (2016). Characterization of Self-Healing Polymers: From Macroscopic Healing Tests to the Molecular Mechanism. In: Martin D. Hager, Sybrand van der Zwaag, Ulrich S Schubert. Self-healing Materials. ADVANCES IN POLYMER SCIENCE, vol. 273, p. 113-142, NEW YORK:Springer, ISBN: 978-3-319-32776-1, ISSN: 0065-3195, doi:10.1007/12\_2015\_341

#### *Tesi di Dottorato*

- Grande AM, "Self-healing ionomer based systems for aerospace applications", Tesi di Dottorato, Politecnico di Milano, Marzo 2014

#### *Articoli in atti di congressi internazionali*

- 1) Mudric T, Francesconi A, Giacomuzzo C, Galvanetto U, Grande AM, Di Landro L (2014). High Velocity Impact Behavior of Composite Sandwich Panels with Self-Healing Capabilities. In: 65th International Astronautical Congress 2014 (IAC 2014). p. 5851-5858, Red Hook, NY:Curran Associates, ISBN: 9781634399869, Toronto, Canada, 29 Sept.-3 Oct. 2014

- 2) Janszen G, Grande AM, Bettini P, Di Landro L (2013). Improved Solutions for Dangerous Liquid Containment. In: Safety and Security Engineering V. p. 379-387, SOUTHAMPTON:WIT Press, ISBN: 9781845647445, Rome, Italy, 17-19 Sept. 2013, doi:10.2495/SAFE130341
- 3) Grande AM, L. Di Landro, G. Janszen, C. Giacomuzzo, A. Francesconi (2012). Self-Healing Behaviour of Ionomers and Ionomer Composites Under Ballistic Impact Tests at Different Speeds. In: Proceedings of the 15th European Conference on Composite Materials. p. 1-6, Padova:ECCM, ISBN: 978-88-88785-33-2, Venice, Italy, 24-28 June 2012
- 4) Mudric T, Giacomuzzo C, Galvanetto U, Francesconi A, Zaccariotto M, Grande AM, Di Landro L (2012). Impact Tests and Simulations for Multifunctional Materials. In: Proceedings of the 15th European Conference on Composite Materials. p. 1-8, Padova:ECCM, ISBN: 978-88-88785-33-2, Venice, Italy, 24-28 June 2012
- 5) Grande AM, Coppi S, Di Landro L, Sala G, Giacomuzzo C, Francesconi A, Rahman MA (2012). An Experimental Study of the Self-Healing Behavior of Ionomeric Systems Under Ballistic Impact Tests. In: Behavior and Mechanics of Multifunctional Materials and Composites 2012. p. 83420U.1-7, WASHINGTON:SPIE, ISBN: 9780819489999, San Diego, CA, USA, 12-15 Mar. 2012, doi:10.1117/12.911870.
- 6) Grande AM, Di Landro L, Bettini P, Baldi A, Sala G (2011). RTM Process Monitoring and Strain Acquisition by Fibre Optics. In: 11th International Conference on the Mechanical Behavior of Materials (ICM11). *PROCEDIA ENGINEERING*, p. 3497-3502, ISSN: 1877-7058, Como, Italy, 5-9 June 2011, doi:10.1016/j.proeng.2011.04.576

*Lavori presentati a congressi internazionali*

- 1) Grande AM, Garcia SJ, van der Zwaag S. "A fracture mechanics-based method to evaluate the healing capability of novel elastomers", European Materials Research Society Fall Meeting (Warsaw, September 2015)
- 2) Grande AM, Martin R, Bijleveld J, Odriozola I, Garcia SJ, van der Zwaag S. "Understanding the interfacial healing behaviour of a disulphide based thermo-responsive elastomer by means of rheological and fracture toughness measurements", European Materials Research Society Fall Meeting (Warsaw, September 2015)
- 3) Antunes PJ, Grande AM, Moura AF, Garcia SJ, Viana JC, van der Zwaag S. "Modelling the non-linear viscoelastic behaviour and damage evolution of a self-healing supramolecular elastomer during uniaxial straining", European Materials Research Society Fall Meeting (Warsaw, September 2015)
- 4) Grande AM, Garcia SJ, van der Zwaag S. "A nonlinear fracture mechanics approach to the assessment of the interfacial healing in self-healing elastomers", 5<sup>th</sup> International Conference on Self-Healing Materials (Durham, June 2015)
- 5) Grande AM, Garcia SJ, van der Zwaag S. "Evaluation of interfacial healing of a supramolecular elastomer by combined fracture and tensile testing", 16<sup>th</sup>

International Conference on Deformation, Yield and Fracture of Polymers  
(Kerkrade, March 2015)

- 6) Grande AM, de Lange PJ, Garcia SJ, van der Zwaag S. "The effect of short aramid fibre reinforcements on the fracture and healing behaviour of a supramolecular elastomer", 7<sup>th</sup> International Conference on Fracture of Polymers, Composites and Adhesives (Les Diablerets, September 2014)
- 7) Grande AM, Castelnovo L, Di Landro L, Sala G, Giacomuzzo C, Francesconi A. Multilayer Composites with Self-Healing Capability based on an EMAA Ionomer. In: International Conference on Composite Materials 2013 (ICCM19). p. 2593-2600, Red Hook, NY:Curran Associates, ISBN: 978-1-62993-199-9, Montreal, Canada, 28 July-2 Aug. 2013
- 8) Baldi A, Grande AM, Bose RK, Airoidi A, Garcia SJ, Di Landro L, van der Zwaag S. A Cohesive Elements Based Model to Describe Fracture and Cohesive Healing in Elastomers. In: ICSHM2013 - Fourth International Conference on Self-Healing Materials. p. 673-676, Ghent:Magnel Lab, ISBN: 9789082073706, Ghent, Belgium, 16-20 June 2013
- 9) Grande AM, Castelnovo L, Quadrio I, Zaffaroni S, Di Landro L. Effects of Na Neutralization Level on the SH Behaviour after Ballistic Tests of EMAA Based Ionomers. In: ICSHM2013 - Fourth International Conference on Self-Healing Materials. p. 30-33, Ghent:Magnel Lab, ISBN: 9789082073706, Ghent, Belgium,
- 10) Grande AM, Rahman MA, Di Landro L, Penco M, Peroni I. Self-Healing Response in Different Ionomer Binary Blends During Projectile Puncture Tests. In: 4th European Conference for Aerospace Sciences (EUCASS), Saint Petersburg, Russia, 4-8 July 2011.
- 11) Grande AM, Rahman MA, Di Landro L, Penco M, Spagnoli G. Self Healing of Blends Based on Sodium Salt of Poly(Ethylene-Comethacrylic Acid)/ Poly(Ethylene-Co-Vinyl Alcohol) and Epoxidized Natural Rubber Following High Energy Impact. In: 3rd International Conference on Self-Healing Materials (ICSHM 2011). p. 1-2, Bath, 27-29 June 2011