

# Nicola Maria Pugno

## CURRICULUM VITAE



UNIVERSITY  
OF TRENTO - Italy

Department of Civil, Environmental  
and Mechanical Engineering



### Education

- 1995: Master Degree in Mechanical Engineering, Politecnico di Torino, 110/110 *cum laude* (20 July 1995).
- 1999: PhD in Structural Engineering, Politecnico di Torino (15 March 1999).
- 2004: Master Degrees in Physics, Facoltà di Scienze Matematiche, Fisiche e Naturali, Università di Torino, 110/110 *cum laude* (29 April 2004).
- 2012-: PhD in Biology, Facoltà di Scienze Matematiche, Fisiche e Naturali, Università di Torino.

### Academic Positions

- 2000: Assistant Professor of Solids and Structural Mechanics (after competition at Politecnico di Torino) at Politecnico di Torino, from 1 October 2000.
- 2005: Associate Professor of Solids and Structural Mechanics (after competition at Politecnico di Bari) at Politecnico di Torino, from 1 October 2005.
- 2009: Founder and Director of the “Laboratory of Bio-inspired Nanomechanics Giuseppe Maria Pugno” at Politecnico di Torino.
- 2012-: Full Professor of Solids and Structural Mechanics (after competition at Politecnico di Bari in 2011) at the University of Trento, from 1 November 2012.
- 2012-: Founder and Director of the “Laboratory of Bio-inspired and Graphene Nanomechanics” at the University of Trento.
- 2013-: Full Professor of Material Science (part-time) at the Queen Mary University of London, from 1 October 2013.  
Scientific Responsible of Graphene Nanocomposites, within the Graphene Flagship, at the Fondazione Bruno Kessler, from 1 October 2013.

### ERC Grants (as Principal Investigator)

- 2011: European Research Council (ERC) Starting (“Consolidator”) Grant, on “Bio-inspired Hierarchical Super Nanomaterials”, 2012-2016 (for a related paper see S.W. Cranford, A. Tarakanova, N. Pugno, M.J. Buehler, [Nonlinear material behaviour of spider silk yields robust webs](#), NATURE (2012), 482, 72-78. Cover Story).
  - 2013: European Research Council (ERC) Proof of Concept, on “Large area replication of biological anti-adhesive nanosurfaces” (for a related paper see J. Zang, Q. Wang, Q. Tu, S. Ryu, N. Pugno, M. Buehler, X. Zhao, [Multifunctionality and control of the crumpling and unfolding of large-area graphene](#), NATURE MATERIALS (2013), 12, 321-325).
  - 2013: European Research Council (ERC) Proof of Concept, on “Super-tough knotted fibers” (for a related paper see N. Pugno. [The “Egg of Columbus” for making the world's toughest fibres](#). PLoS ONE (2014), 9 (4), e93079 (6 pp.)).
- Also PI at FBK of WP10 Nanocomposites within the Graphene Flagship (for a related paper see P. H. Tan, W. P. Han, W. J. Zhao, Z. H. Wu, K. Chang, H. Wang, Y. F. Wang, N. Bonini, N. Marzari, N. Pugno, G. Savini, A. Lombardo, A. C. Ferrari, [The shear mode of multi-layer graphene](#), NATURE MATERIALS (2012), 11, 294-300.)

## **Main research topics**

1. Bio-inspired hierarchical super nanomaterials (e.g. self-healing)
2. Super-strong graphene, nanotubes and related bundles and composites (e.g. flaw tolerant space elevator cables)
3. Smart adhesion of insects, spiders and geckos and related gecko-inspired nanostructured surfaces (e.g. Spiderman suits)
4. Self-cleaning & anti-adhesive super-hydrophobic leaves and related lotus-inspired nanostructured surfaces (e.g. anti-ice)
5. Spider-silk and web and related inspired super-tough materials and structures (e.g. anti-catastrophes)
6. Design and fabrication of Nano Electro Mechanical Systems (e.g. nanotubes or graphene based)
7. Hierarchical fibre bundle models, ropes, tissues and cellular solids (e.g. role of hierarchy)
8. Graphene nanoscrolls and related systems (e.g. nanomotors)
9. Nanomedicine: tumor cellular growth, nanovector therapeutics and scaffolds for the regenerative medicine (e.g. flexible nanovectors)
10. Nanoindentation and related size- and shape-effects (e.g. universal scaling laws on hardness)
11. Quantized Fracture Mechanics, in quasi-static, dynamic and fatigue regimes (e.g. role of defects in graphene)
12. Nanoscale Weibull & Fractal Statistics and related size-effects on material strength (e.g. nanotubes statistics)
13. Multiscale fragmentation under impact and explosions and structural dynamics (e.g. universal scaling laws on energy dissipation)

## **Editorial Boards**

Editor-in-chief of Bio-Inspired Materials (De Gruyter)

Editor-in-chief of Frontiers in Materials – Mechanics (Frontiers)

Academic Editor of PlosOne (PlosOne)

Editorial Board for Biological Physics of Scientific Reports (Nature Publishing Group)

Member of editorial boards of other 46 international journals.

## **Visiting scholar and professor**

- 2003: Visiting Scholar at Northwestern University (Evanston, Illinois, USA) August-February, on nanoelectromechanical systems, with Prof. H.D. Espinosa.
- 2004: Visiting Scholar at Northwestern University (Evanston, Illinois, USA), August, on graphene, with Prof. R.S. Ruoff.
- 2005: Visiting Professor at Max Planck Institute (Stoccarda, Germany), May, on bio-inspired adhesion, with Prof. H. Gao.
- 2005: Visiting Professor at Aristotle University of Thessaloniki (Salonicco, Greece), July, on gradient elasticity, with Prof. E. Aifantis.
- 2008: Visiting Professor at Florida State University (Tallahassee, Florida, USA), May-April, with Nobel prize winner Prof. H. Kroto.
- 2009: Visiting Professor at Brown University (Providence, Rhode Island, USA), May, on graphene nanoscrolls, with Prof. H. Gao.
- 2009: Visiting Professor at Massachusetts Institute of Technology (Boston, Massachusetts, USA), May, on nanomechanics of biological materials, with Prof. M. Buehler.
- 2009: Visiting Professor at Cambridge University (Cambridge, UK), June, on nanotube bundles, with Prof. A. Windle.
- 2009: Visiting Professor at Centre for Advanced Photonics and Electronics (Cambridge, UK), June, on graphene, with Prof. A. Ferrari.
- 2011: Visiting Professor at Massachusetts Institute of Technology (Boston, Massachusetts, USA), June, on spidersilk, with Prof. M. Buehler.

- 2012: Visiting Professor at Northwestern University (Evanston, Illinois, USA), April, on self-healing materials, with Prof. S. Keten and with Prof. H.D. Espinosa.
- 2012: Visiting Professor at Massachusetts Institute of Technology (Boston, Massachusetts, USA), April, on spidersilk, with Prof. M. Buehler.
- 2012: Visiting Professor at Centre for Advanced Photonics and Electronics and Cambridge University (Cambridge, UK), May, on graphene, with Prof. A. Ferrari.
- 2012: Visiting Professor at Massachusetts Institute of Technology (Boston, Massachusetts, USA), November, on spidersilk, with Prof. M. Buehler.
- 2012: Visiting Professor at State University of Campinas - UNICAMP (San Paolo, Brasile), December, on graphene nanoscrolls, with Prof. D. Galvao.

### **Organization of schools and conferences**

- “Advanced and Bio-Inspired Nanomechanics”, International Centre for Mechanical Sciences, Udine, Luglio 18-12, 2011.
- “2nd International Summer School on Smart Materials and Structures”, Università di Trento, Trento, Luglio 22-26, 2013 (with D. Zonta).
- “New frontiers in multiscale modeling of advanced materials”, European Centre for Theoretical studies in nuclear physics and related areas, Villazzano (Trento), Giugno 24-27, 2014 (with S. Taioli and M. Dapor).
- “3rd International Summer School on Smart Materials, Structures and Systems”, Università di Trento, Trento, Luglio 21-25, 2014 (with D. Zonta and O. Bursi).
- Falling Walls Lab Italy, Università di Trento, 3 Ottobre 2014, Trento, Italy.
- Local Committee of the Int. Conf. on Fracture XI, March 20-25, 2005, Torino, Italy.
- Organizer Committee of Nanoscience & Nanotechnology, October 20-23, 2008, Frascati, Italy.
- Topic Organizer of “Nano- or Micro-scale” at the Int. Conf. on Fracture XII, July 12-17, 2009, Ottawa, Canada, USA.
- Organizer Committee of Nanoscience & Nanotechnology, October 19-22 2009, Frascati, Italy.
- Organizer Committee of Nanoscience & Nanotechnology, September 20-22 2010, Frascati, Italy.
- Organizer Committee of Nanoscience & Nanotechnology, September 19-23 2011, Frascati, Italy.
- Organizer Committee of Nanoscience & Nanotechnology, October 1-4 2012, Frascati, Italy.
- Organizer Committee of Nanoscience & Nanotechnology, September 30 – October 4, 2013, Frascati, Italy.
- Co-organizer of Minisymposium “Micro- or nano-mechanics” at the XX Congresso AIMETA, September 12-15, 2011, Bologna, Italy.
- Co-organizer of Symposium “De Novo Graphene and Carbon Nanomaterials” at Material Research Society Spring 2012 Meeting, April 9-13, 2012, San Francisco, California.
- Co-organizer of Symposium “Nanocomposites” at the First International Conference on Mechanics of Nano, Micro and Macro Composite Structures, June 18-20, 2012, Torino, Italy.
- Member of the International Scientific Committee of the Int. Conf. on Fracture 13, June 16-21, 2013, Beijing, China.
- Co-Chair (con H. Gao, R. Ritchie and Y. Lin) of Session (5) “Biomaterials and Tissues” at the Int. Conf. on Fracture 13, June 16-21, 2013, Beijing, China.
- Co-Chair (con D. Bigoni) of Minisymposium (6) “Materials and Structures under severe conditions” at the Int. Conf. on Fracture 13, June 16-21, 2013, Beijing, China.
- Member of the International Scientific Committee of the Congress on Modelling and Simulation meet Innovation in Ceramics Technology, July 10-12, 2013, Trento, Italy
- Co-organizer (with A. Corigliano and S. Mariani) of Special Symposium (SS7) “Smart Micro and Nano Structures and Materials” at 6th ECCOMAS THEMATIC CONFERENCE ON SMART STRUCTURES AND MATERIALS: SMART2013, June 24-26, 2013, Torino, Italy.
- Co-organizer of the Symposium “Soft Nanomaterials” at the Material Research Society Spring 2014 Meeting, April 21-25, 2014, San Francisco, California.
- Co-organizer (with E. Barbieri) of Minisymposium “Nanomechanics and Micromechanics” at the 9th European Solid Mechanics Conference, 6-10 July 2015, Madrid, Spain.

## International journal papers

236. S. Panzavolta, B. Bracci, C. Gualandi, E. Treossi, K. Kouroupis-Agalou, K. Rubini, M. L. Focarete, F. Bosia, L. Brely, N. Pugno, V. Palermo, A. Bigi. [Structural reinforcement and failure analysis in composite nano fibers of graphene oxide and gelatin](#). CARBON (2014) [In Press].
235. F. Bosia, S. Colella, V. Mattoli, B. Mazzolai, N. Pugno. [Hierarchical multiple peeling simulations](#). RSC ADVANCES (2014), 4, 25447–25452.
234. M. Piccardo, F. Bosia, P. Olivero, N. Pugno. [An analytical model for the mechanical deformation of locally graphitized diamond](#). DIAMOND AND RELATED MATERIALS (2014), 48, 73–81.
233. A. Meyer, N. Pugno, S. W. Cranford. [Compliant threads maximize spider silk connection strength and toughness](#). JOURNAL OF THE ROYAL SOCIETY INTERFACE (2014), 11, 20140561 (14 pp.).  
[Supplementary video](#) S1  
[Supplementary video](#) S2  
[Supplementary video](#) S3  
[Supplementary video S4](#)
232. C. Androulidakis, E. N. Koukaras, O. Frank, G. Tsoukleri, D. Sfyris, J. Parthenios, N. Pugno, K. Papagelis, K.S. Novoselov, C. Galiotis. [Failure Processes in Embedded Monolayer Graphene under Axial Compression](#). SCIENTIFIC REPORTS (2014), 5, 5271 (8 pp.).
231. K. Koroupis-Agalou, A. Liscio, E. Treossi, L. Ortolano, V. Morandi, N. Pugno, V. Palermo. [Fragmentation and exfoliation of 2-dimensional materials: a statistical approach](#). NANOSCALE (2014), 6, 5926-5933.
230. Z. Qin, N. Pugno, M.J. Buehler. [Mechanics of fragmentation of crocodile skin and other thin films](#). SCIENTIFIC REPORTS (2014), 4:4966.
229. S. Signetti, N. Pugno. [Evidence of optimal interfaces in bio-inspired ceramic-composite panels for superior ballistic protection](#). JOURNAL OF THE EUROPEAN CERAMIC SOCIETY (2014), 34, 2823-2831.
228. M.F. Pantano, N. Pugno. [Design of a bent beam electrothermal actuator for in situ tensile testing of ceramic nanostructures](#). JOURNAL OF THE EUROPEAN CERAMIC SOCIETY (2014), 34, 2767-2773.
227. Q. Chen, F. Baino, S. Spriano, N. Pugno, C. Vitale-Brovarene. [Modelling of the strength-porosity relationship in glass-ceramic foam scaffolds for bone repair](#). JOURNAL OF THE EUROPEAN CERAMIC SOCIETY (2014), 34, 2663-2673.
226. N. Pugno. [The unacknowledged risk of Himalayan avalanche triggering](#). INTERNATIONAL JOURNAL OF FRACTURE (2014), 187, 277-283.
1. N. Pugno. [The "Egg of Columbus" for making the world's toughest fibres](#). PLoS ONE (2014), 9 (4), e93079 (6 pp.).
224. S. Huang, Z. Cheng, N. Pugno, Q. Cheng, W. Wang. [A novel model for porous scaffolds to match the mechanical anisotropy and the hierarchical structure of bone](#). MATERIALS LETTERS (2014), 122, 315-319.
223. E. Perim, A.F. Fonseca, N. Pugno, D.S. Galvao. [Violation of the universal behaviour of membranes inside cylindrical tubes at the nanoscale](#). EUROPHYSICS LETTERS (2014), 105, 56002, 4pp..
222. F. Bosia, T. Abdalrahman, N. Pugno. [Self-Healing of Hierarchical Materials](#). LANGMUIR (2014), 30, 1123-1133.
221. Q. Chen, N. Pugno, K. Zhao, Z. Li. [Mechanical properties of a hollow-cylindrical-joint honeycomb](#). COMPOSITE STRUCTURES (2014), 109, 68-74.
220. M. Zheng, X. Chen, C. Park, C. C. Fay, N. M. Pugno, C. Ke. [Nanomechanical cutting of boron nitride nanotubes by atomic force microscopy](#). NANOTECHNOLOGY (2013), 24, 505719/1-11.
219. L. Afferrante, G. Carbone, G. Demelio, N. Pugno. [Adhesion of Elastic Thin Films: Double Peeling of Tapes Versus Axisymmetric Peeling of Membranes](#). TRIBOLOGY LETTERS (2013), 52, 439-447
218. T. Giesa, N. M. Pugno, J. Y. Wong, D. L. Kaplan, M. J. Buehler. [What's Inside the Box? – Length-Scales that Govern Fracture Processes of Polymer Fibers](#). ADVANCED MATERIALS (2013).
217. Y. Sun, Q. Chen, N. Pugno. [Elastic and transport properties of the tailorable multifunctional hierarchical honeycombs](#). COMPOSITE STRUCTURES (2014), 107, 698-710.
216. X. Shi, Q. Yin, N. M. Pugno, H. Gao. [Tunable mechanical behavior of carbon nanoscroll crystals under uniaxial compression](#). JOURNAL OF APPLIED MECHANICS (2014), 81, 021016/1-6.
215. Y. Cheng, N. M. Pugno, X. Shi, B. Chen, H. Gao. [Surface energy controlled self-collapse of carbon nanotube bundles with large and reversible volumetric deformation](#). JOURNAL OF APPLIED MECHANICS (2013), 80, 040902/1-5.
214. S. Huang, Z. Li, Z. Chen, Q. Chen, N. Pugno. [Study on the elastic-plastic behavior of a porous hierarchical bioscaffold for bone regeneration](#). MATERIALS LETTERS (2013), 112, 43-46.
213. F. Bosia, N. Pugno. [In silico tensile test and design of hierarchical graphene fibres and composites](#). PHYSICA STATUS SOLIDI B (2013), 250, 1492-1495.
212. Q. Chen, N. Pugno, Z. Li. [Influence of surface stress on elastic constants of nanohoneycombs](#). PHYSICA E (2013), 53, 217-222.
211. Y. Sun, N. Pugno. [In plane stiffness of multifunctional hierarchical honeycombs with negative Poisson's ratio sub-structures](#). COMPOSITE STRUCTURES (2013), 106, 681-689.
210. E. Jomehzadeh, M.K. Afshar, C. Galiotis, X. Shi, N. M. Pugno. [Nonlinear softening and hardening nonlocal bending stiffness of an initially curved monolayer graphene](#). INTERNATIONAL JOURNAL OF NONLINEAR MECHANICS (2013), 56, 123-131. Invited paper for the Special Issue on "Soft Matter: a nonlinear Continuum Mechanics perspective".
209. E. Lepore, P. Brambilla, A. Pero, N. M. Pugno. [Observations of shear adhesive force and friction of "Blatta orientalis" on different surfaces](#). MECCANICA (2013), 48, 1863-1873. Special Issue "Micro and Nano Mechanics", Guest Editors Alberto Corigliano and Nicola Pugno.
208. N. M. Pugno, Q. Yin, X. Shi, R. Capozza. [A generalization of the Coulomb's friction law: from graphene to macroscale](#). MECCANICA (2013), 48, 1845-1851. Special Issue "Micro and Nano Mechanics", Guest Editors Alberto Corigliano and Nicola Pugno.
207. A. Corigliano, N. M. Pugno. [Micro- or nano-mechanics](#). MECCANICA (2013), 48, 1817-1818. Special Issue "Micro and Nano Mechanics", Guest Editors Alberto Corigliano and Nicola Pugno.
206. N. M. Pugno, S. Cranford and M. J. Buehler. [Synergetic material and structural optimization yields robust spider web anchorages](#). SMALL (2013), 9, 2747-2756.

205. N. Pugno, [The effect of collapsed nanotubes on nanotube bundle strength](#), INT. SPACE ELEVATOR CONSORTIUM J., CLIMB (2012), 2, 25-30.
204. M. Piccardo, A. Chateauminois, C. Fretigny, M. Sitti, N. M. Pugno, [Contact compliance effects in the frictional response of biomimetic fibrillar adhesives](#), JOURNAL OF THE ROYAL SOCIETY INTERFACE (2013), 10, 20130182.
203. E. Lepore, M. Giorcelli, C. Saggese, A. Tagliaferro, N. Pugno, [Mimicking water striders' legs superhydrophobicity with cabbage leaves and nanotube carpets](#), JOURNAL OF MATERIALS RESEARCH (2013), 28, 976-983.
202. E. Lepore, C. Chappoz, D. Cipriano Monetta, N. M. Pugno, [Surface roughness, claw size and leg elasticity influences on the jumping of Acheta domesticus crickets](#), COMPOSITE STRUCTURES (2013), 100, 609-616.
201. N. Pugno, [An unacknowledged risk at 8000m... and The "universal" model for avalanche triggering and sérac collapse](#), THE ALPINE JOURNAL (2013), in Nicola Pugno, Giulio Caresio, Silvio Mondinelli, Critical Factors for Himalayan Avalanches – An investigation prompted by the 2012 Manaslu tragedy, pp. 128-137. Invitation for the 150th Anniversary of The Alpine Journal.
200. Q. Chen, F. Baino, N. M. Pugno, C. Vitale, [Bonding strength between glass-derived trabecular-like coatings and ceramic substrates for bone tissue engineering: advances towards a rational design of biomaterials](#), MATERIALS SCIENCE AND ENGINEERING C (2013), 33, 1530-1538.
199. C. S. Ozkan, M. J. Buehler, N. M. Pugno, K. Wang, Editorial: [De Novo Carbon Nanomaterials: Opportunities and Challenges in a Flat World](#), JOURNAL OF MATERIAL RESEARCH (2013), 28, 909-911.
198. F. Bosia, F. Della Croce, N. M. Pugno, [Systematic numerical investigation of the role of hierarchy in heterogeneous bio-inspired materials](#), JOURNAL OF THE MECHANICAL BEHAVIOR OF BIOMEDICAL MATERIALS (2013), 19, 34-42.
197. Q. Chen, N. M. Pugno, [Bio-mimetic mechanisms of natural hierarchical materials: A review](#), JOURNAL OF THE MECHANICAL BEHAVIOR OF BIOMEDICAL MATERIALS (2013), 19, 3-33.
196. Y. Sun, N. Pugno, [Hierarchical fiber with negative Poisson's ratio for tougher composites](#), MATERIALS (2013), 6, 699-712.
195. J. Zang, Q. Wang, Q. Tu, S. Ryu, N. Pugno, M. Buehler, X. Zhao, [Multifunctionality and control of the crumpling and unfolding of large-area graphene](#), NATURE MATERIALS (2013), 12, 321-325.  
[Supplementary video S1](#)  
[Supplementary video S2](#)  
[Supplementary video S3](#)
194. Q. Chen, S. Gorb, E. Gorb, N.M. Pugno, [Mechanics of plant fruit hooks](#). JOURNAL OF ROYAL SOCIETY INTERFACE (2013), 10, 20120913.
193. N. Pugno, [Towards the Artsutanov's dream of the space elevator: the ultimate design of a 35GPa stronger tether thanks to graphene](#). ACTA ASTRONAUTICA (2013), 82, 221-224.
192. N. Pugno, T. Abdalrahman, [Multimodal Daniels' theory: an application to CNT twisted strands](#). COMPOSITES PART B: ENGINEERING (2013), 45, 303-307.
191. Q. Chen, N. M. Pugno, [In-plane elastic properties of hierarchical nano-honeycombs: the role of the surface effect](#). EUROPEAN JOURNAL OF MECHANICS A/SOLIDS (2013), 37, 248-275.
190. Y. Sun, N. Pugno, [Optimal hierarchical architectures to maximize the strength-to-weight ratio of bi-materials](#). NANOSCIENCE AND NANOTECHNOLOGY LETTERS (2012), 4, 1068-1073.
189. N. Pugno, T. Abdalrahman, [Peeling experiments of double side adhesive tapes suggests the feasibility of graphene nanocomposites with gigantic toughness](#). NANOSCIENCE AND NANOTECHNOLOGY LETTERS (2012), 4, 1064-1067.
188. E. Jomehzadeh, A.R. Saidi, N. M. Pugno, [Large amplitude vibration of a bilayer graphene sheet embedded in a nonlinear polymer matrix](#), PHYSICA E (2012), 44, 1973-1982.
187. T. Giesa, N. M. Pugno, M. J. Buehler, [Natural stiffening increases flaw tolerance of biological fibers](#). PHYSICAL REVIEW E (2012), 86, 041902, 1-7.
186. E. Lepore, F. Pugno, N. M. Pugno, [Optimal angles for maximal adhesion in living tokay geckos](#), J. OF ADHESION (2012), 88, 820-830.
185. N. Pugno, L. Calabri, [Nanoindentation and nanoscratch of hybrid metallic-organic framework material](#). MATERIALS SCIENCE AND TECHNOLOGY (2012), 28, 1156-1160. Invited paper for the Special Issue MS&T 2011 on "Hardness across the multiscales".
184. X. Shi, B. Peng, N. M. Pugno, H. Gao, [Stretch-induced softening of bending rigidity in graphene](#). APPLIED PHYSICS LETTERS (2012), 100, 191913 (5pp).
183. Q. Chen, N.M. Pugno, [In-plane elastic buckling of hierarchical honeycomb materials](#), EUROPEAN JOURNAL OF MECHANICS A/SOLIDS (2012), 34, 120-129.
182. N. Pugno, J. Elliott, [Buckling of peapods, fullerenes and nanotubes](#), PHYSICA E (2012), 44, 944-948. Special Issue E-MRS 2010.
181. Y. Cheng, X. Shi, N. Pugno, H. Gao, [Substrate-supported carbon nanoscroll oscillator](#), PHYSICA E (2012), 44, 955-959. Special Issue E-MRS 2010.
180. N. Pugno, [Nanomechanics... at the service of mankind...](#) PUBLIC SERVICE REVIEW (2012), 23, 618.
1. P. H. Tan, W. P. Han, W. J. Zhao, Z. H. Wu, K. Chang, H. Wang, Y. F. Wang, N. Bonini, N. Marzari, N. Pugno, G. Savini, A. Lombardo, A. C. Ferrari, [The shear mode of multi-layer graphene](#), NATURE MATERIALS (2012), 11, 294-300.
178. Q. Chen, N.M. Pugno, [Competition between in-plane buckling and bending collapses in nano-honeycombs](#), EUROPHYSICS LETTERS (2012), 98, 16005 (5pp).
177. E. Lepore, A. Marchioro, M. Isaia, M. J. Buehler, N. Pugno, [Evidence of the most stretchable egg sac silk stalk, of the European spider of the year Meta Menardi](#). PLoS ONE (2012), 7(2), e30500 (12pp).
176. F. Bosia, T. Abdalrahman, N. M. Pugno, [Investigating the role of hierarchy on the strength of composite materials: evidence of a crucial synergy between hierarchy and material mixing](#), NANOSCALE (2012), 4, 1200-1207. Themed Issue: Modelling for the nanoscale.
1. S.W. Cranford, A. Tarakanova, N. Pugno, M.J. Buehler, [Nonlinear material behaviour of spider silk yields robust webs](#), NATURE (2012), 482, 72-78. Cover Story and 18 pages of Supplementary Information, DOI 10.1038/nature10739.

174. E. Lepore, P. Faraldi, D. Bongini, L. Boarino, N. M. Pugno, [Plasma and thermoforming treatments to tune the bio-inspired wettability of polystyrene](#). COMPOSITES PART B: ENGINEERING (2012), 43, 681-690.
173. N. Pugno, F. Bosia, T. Abdalrahman, [Hierarchical fiber bundle model to investigate the complex architectures of biological materials](#). PHYSICAL REVIEW E (2012), 85, 011903 (8 pp.).
172. Q. Chen, N. Pugno, [Mechanics of hierarchical 3-D nanofoams](#), EUROPHYSICS LETTERS (2012), 97, 26002 (6 pp.).
171. N. Pugno, A. Konstantinidis, P. Cornetti, E.C. Aifantis, [ERRATUM on Application of Gradient Theory and Quantized Fracture Mechanics in Snow Avalanches](#), J. OF THE MECHANICAL BEHAVIOUR OF MATERIALS, 2011, 20, 107-109.
170. N. Pugno, T. Abdalrahman, [Catastrophic failure of nanotube bundles, interpreted with a new statistical nonlinear theory](#). NANOSCIENCE AND NANOTECHNOLOGY LETTERS, Special Issue on Nanoscience and Nanotechnology (2011), 3, 882-884.
169. E. Gualtieri, N. Pugno, A. Rota, A. Spagni, E. Lepore, S. Valeri, [Tribology and wettability of nano-machined silicon rough surfaces](#). J. OF NANOSCIENCE AND NANOTECHNOLOGY (2011), 11, 9244-9250.
168. T. Giesa, M. Arslan, N. M. Pugno, M. J. Buehler, [Nanoconfinement of spider silk fibrils begets superior strength, extensibility and toughness](#). NANO LETTERS (2011), 11, 5038-5046.
167. N. Pugno, T. Abdalrahman, [Modeling the self-healing of biological or bio-inspired nanomaterials](#), INTERNATIONAL SPACE ELEVATOR CONSORTIUM JOURNAL, CLIMB (2011), 1, 79-86.
166. N. Pugno, [The theory of multiple peeling](#). INTERNATIONAL JOURNAL OF FRACTURE (2011), ICF XII Special Issue on Nanoscale Fracture, Guest Editor Nicola M. Pugno (2011), 171, 185-193 (published as arXiv: 0903.0935 cond-mat, 5 march 2009).
165. A. Pantano, N. Pugno, S. Gorb, [Numerical simulations demonstrate that the double tapering of the spatulae of lizards and insects maximize both detachment resistance and stability](#). INT. J. OF FRACTURE, ICF XII Special Issue on Nanoscale Fracture, Guest Editor Nicola M. Pugno (2011), 171, 169-175.
164. X. Shi, N. Pugno, H. Gao, [Constitutive behaviour of pressurized carbon nanoscrolls](#). INTERNATIONAL JOURNAL OF FRACTURE, ICF XII Special Issue on Nanoscale Fracture, Guest Editor Nicola M. Pugno (2011), 171, 163-168.
163. N. Pugno, [Nanoscale Fracture](#). INTERNATIONAL JOURNAL OF FRACTURE, introduction to the ICF XII Special Issue on Nanoscale Fracture, Guest Editor Nicola M. Pugno (2011), 171, 151-153.
162. N. Pugno, E. Lepore, S. Toscano, F. Pugno, [Adhesion force-displacement curves of living geckos](#). JOURNAL OF ADHESION (2011), 87, 1059-1072.
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