Nanotechnology and Nanomaterials for diagnostics, conservation and restoration @ University of Rome "Tor Vergata"

Dr. Giulia Festa

Physics Department and Centro NAST

On behalf of the team from Rome "Tor Vergata"

Nano Innovation 2016 Rome, 20-23 September Conference & Exhibition

TECHINICAL SESSION.VIII.B Nanotechnology and nanomaterial for cultural heritage

Università di Roma Tor Vergata

Cultural Heritage

(Ceramics, wood, metals, stones, papers and papyri, textiles, etc.)

Instrumentation Methods Techniques

Sensors and Monitoring

Dissemination, 3D Data Base and Management

Diagnostics, GIS Platform

Restoration and Conservation

Keywords: Arboreal Species preservation, Authenticity evaluation, Bio-chemical analysis, Bio-deterioration, Characterization, Conservation and Consolidation of artefacts, 3D Databases, Dating, GIS platforms, Nanomaterials, Neutrons and Light Techniques, Imaging, Instrument development, Meteorological monitoring, Microclimatic conditions, Molecular Anthropology, Paleodiet, Physical-Chemical techniques, Preventive archaeology, Survey and analysis of buildings, Stratigraphy of archaeological sites, Territorial planning

This Research is carried out in synergy among experts of several disciplines such as biology, chemistry, economics, engineering, humanities, physics

EXAMPLE 1: ORIGIN OF CELIAC DISEASE

Università di Roma Tor Vergata

World Journal of Gastroenterology

Origin of celiac disease: How old are predisposing haplotypes?

Giovanni Gasbarrini, Olga Rickards, Cristina Martínez-Labarga, Elsa Pacciani, Filiberto Chilleri, Lucrezia Laterza, Giuseppe Marangi, Franco Scaldaferri, Antonio Gasbarrini

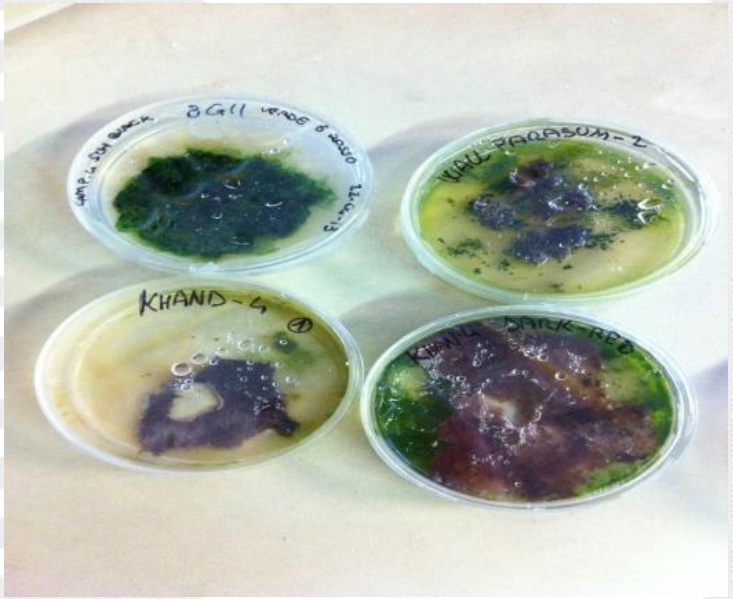
AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY 154:349–356 (2014)

Palaeodiet Reconstruction in a Woman With Probable Celiac Disease: A Stable Isotope Analysis of Bone Remains From the Archaeological Site of Cosa (Italy)

Gabriele Scorrano,[1]* Mauro Brilli,[2] Cristina Martínez-Labarga,[1] Francesca Giustini,[2] Elsa Pacciani,[3] Filberto Chilleri,[3] Franco Scaldaferri,[4] Antonio Gasbarrini,[4] Giovanni Gasbarrini,[5] and Olga Rickards[1]

- Ancient bones show signs of struggle with coeliac disease
- Palaeodiet Reconstruction in a Woman With Probable Celiac Disease through the study of stable isotopes of Carbon and Nitrogen

EXAMPLE 2: APPLICATION OF NANODIAMONS AND NANOGRAPHENE OXIDE



International Journal of Nanomedicine

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ORIGINAL RESEARCH

Nanodiamonds coupled with 5,7-dimethoxycoumarin, a plant bioactive metabolite, interfere with the mitotic process in B16F10 cells altering the actin organization

The Conservation of Subterranean Cultural Heritage – Saiz-Jimenez (Ed)
© 2014 Taylor & Francis Group, London, ISBN 978-1-138-02694-0

NanoGraphene Oxide: a new material for a non-invasive and non-destructive strategy to remove biofilms from rocks surfaces

L. Bruno
Dept. of Biology, Univresity of Rome 'Tor Vergata', Rome, Italy

L. Quici
University of Perugia PhD Student, Perugia, Italy

I. Ficorella & F. Valentini
Dept of Chemistry, University of Rome 'Tor Vergata', Rome, Italy

- The functionalization of nanodiamonds (i.e. citroptene) **as inibitors of** microorganism growing such as *Scytonema* sp., *Micrococcus* sp. and *Fischerella* sp., on monuments of cultural heritage interest.
- NanoGraphene Oxide tested as byocite of microorganism on stone monuments of cultural heritage interest.

EXAMPLE 3: Electrochemical diagnostic tool with hydrogels (paper and wood)

Hydrogel has been used

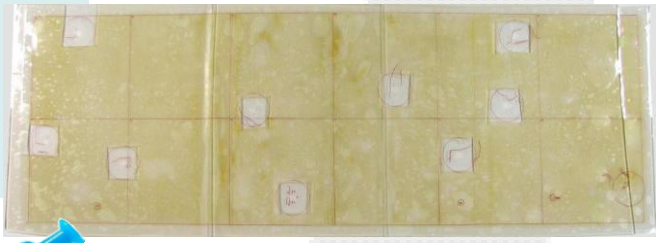
1) as **cleaning agent** for:

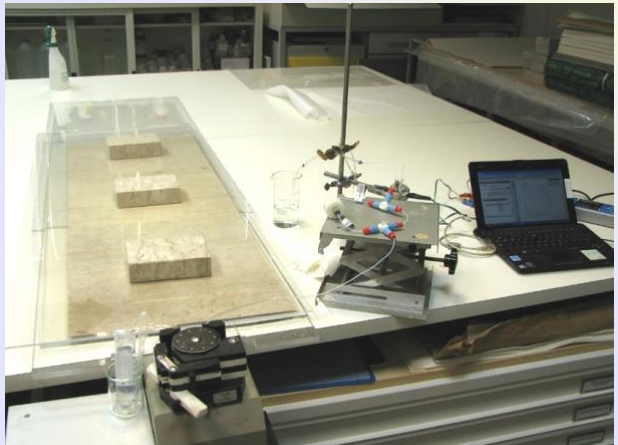
- removal of degradation products of cellulose
- removal of the pollulants

2) as **a carrier for tuned cleaning agents** for:

- removal of aged glue (i. e. in linings) throught the enzymatic hydrolisis of used starch or animal glues

3) As a **support** for **non invasive** diagnostic measurements

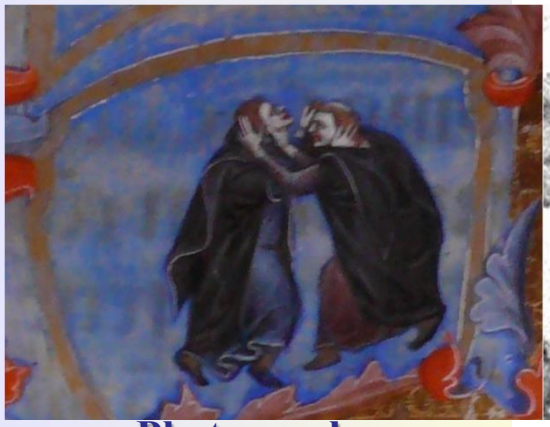




Corso di Laurea Magistrale a ciclo unico in Conservazione e Restauro dei Beni Culturali-PFP5 (Materiale librario e archivistico; Manufatti cartacei; Materiale fotografico, cinematografico e digitale)

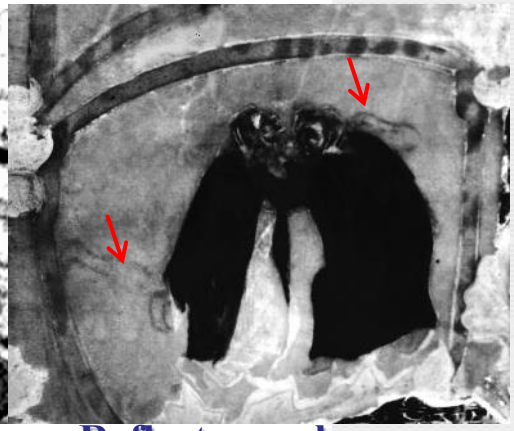
EXAMPLE 4: IR Termography and reflectography

Miniatures in the *Liber Regulae S. Spirito* (Archivio di Stato di Roma) – XIV SEC.



Photography

Thermography



Reflectography

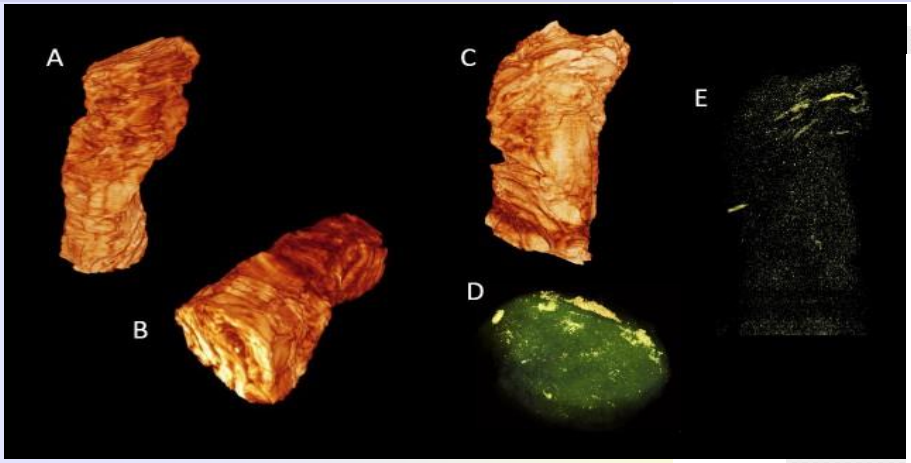
→ **'Pentimento'**: variation respect to the drowing

→ Sub superficial defect

→ **'Pentimento':** two figures were **covered** by painting

EXAMPLE 5

X-Ray-Phase-Contrast-tomography brings back 2000-years-old "Voice" od Epicurean Philosopher Philodemus



RESULTS: Largest portion of Philodemus Greek texts **ever detected** inside **unopened carbonized Herculaneum papyri scrolls**, through a **virtual unrolling and deciphering** using enhanced **X-ray phase-contrast tomography**.

Neutrons and X-ray imaging of wood musical instruments

Musical instruments from the '***Fondo Antico della Biblioteca del Sacro Convento***' in *Assisi*, Italy, characterized by Neutron and X-ray radiographies-tomographies.

G. Festa, G. Tardino, L. Pontecorvo, D. C. Mannes, **R. Senesi**, G. Gorini, **C. Andreani** ,, *NIM B,* **336**, 63–69 (2014)

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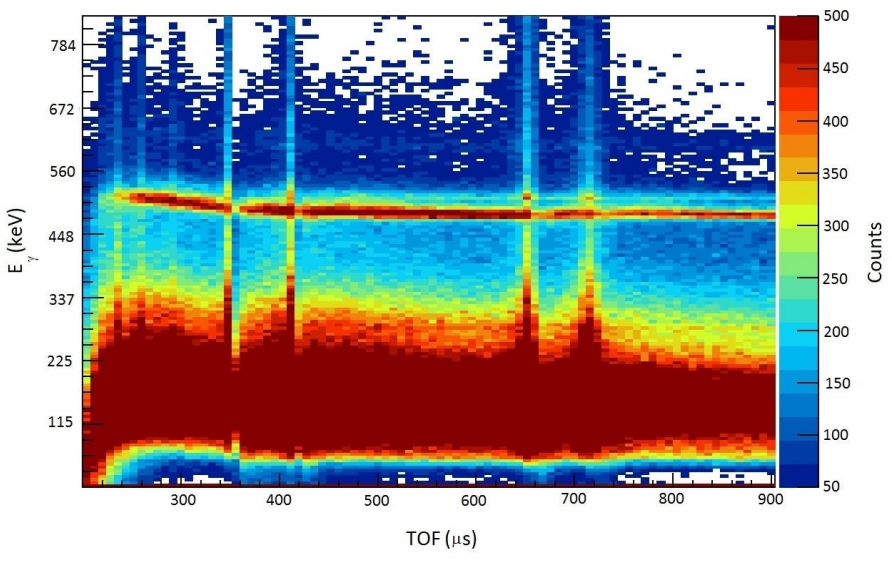
I. Bukreeva, A. Mittone, A. Bravin, **G. Festa,** M. Alessandrelli, P. Coan, V. Formoso, R. G. Agostino, M. Giocondo, F. Ciuchi, M. Fratini, L. Massimi, A. Lamarra, **C. Andreani**, R. Bartolino, G. Gigli, G. Ranocchia, A. Cedola, Scientific Reports 6:27227 (2016)

EXAMPLE 6 - Time-Resolved Prompt Gamma Activation Analysis



New **combined technique for isotopic analysis**, through incident neutron energy selection in prompt gamma spectrum for multicomponent samples

APPLICATION:
Cultural Heritage (i.e. metals, ceramics, etc.)

G. Festa, **L. Arcidiacono**, A. Pappalardo, T. Minniti, C. Cazzaniga, A.Scherillo, **C. Andreani** and **R. Senesi**, 'Isotope identification capabilities using time resolved prompt gamma emission from epithermal neutrons', *Journal of Instrumentation*, International workshop on Imaging, Varenna, Italy (2016)

Credits and Acknowledgements:

- A. Canini, L. Bruno, C. Martinez-Labarga, O. Rickards - *Department of Biology*
- C. Andreani, G. Festa, R. Senesi, - *Department of Physics and Centro NAST*
- C. Conte, S. Licoccia, C. Mazzuca, L. Micheli, S. Orlanducci, G. Palleschi, A. Palleschi - *Department of Chemistry*
- C. Cornaro, N. Marconi, A. Spena, U. Zammit - *Engineering*
- M. Fabbri, A. Molinari, M.F. Rolfo - *Department of History, Cultural Heritage, Training and Society*
- M. R. Falivene – *Department of Humanities, Philosophy and Art History*
- M. Prezioso - *Department of Management and Law*

Thank you

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