Rudjer Bošković Institute, Zagreb, Croatia

500 academic staff and graduate students work on problems in experimental and theoretical physics, chemistry and physics of materials, organic and physical chemistry, biochemistry, molecular biology and medicine, environmental and marine research and computer science and electronics

Laboratory for Bioelectrochemistry and Surface Imaging

Division for Marine and Environmental Research

Vesna Svetličić
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Senior scientist, Ruđer Bošković Institute
Professor, University of Split

Research

Rudjer Bošković Institute
University of Minnesota, Department of Chemistry, Minneapolis, USA

Collaboration

•Scripps Institution of Oceanography, Marine Biology Division, UCSD, La Jolla, USA
•Laboratoire d'Electrochimie Interfaciale, Meudon, CNRS , France
•Universite P. et M. Curie, Paris 6, Laboratoire d'Electrochimie, CNRS, Paris, France

Teaching

•Experimental Methods of Physics in Biophysics
Interdisciplinary Doctoral Study in Biophysics, University of Split
•Marine organic matter organization and function
Interdisciplinary Doctoral Study in Oceanography, University of Zagreb

Laboratory was established in 2008
Previously Group for bioelectrochemistry and surface imaging within the Laboratory for ecological modeling

Long tradition and recognition in the development of electrochemical methodology and biophysical concepts into marine research

AFM facility

Own research - characterization of marine processes at the nanoscale.
Education – implementation of AFM in the university studies curricula in Croatia
Use of AFM in other research areas – e.g. *zeolites at the nanoscale*, gel phase and crystal growth; *molecular structure of functional monolayers* at single crystal surfaces; *biocorrosion* of dental alloys; *textile fabrics*, different plasma treatments and silver nanoparticles distribution.

Members of the laboratory

Galja Pletikapić
research assistant, at RBI since June 2009
B. Sc. Biotechnology. Molecular biology
Interdisciplinary doctoral study in oceanology
PhD thesis: ***Nanomechanical properties of diatom surfaces and extracellular polymer substances measured by AFM***
AFM training, R&D laboratory, Veeco Instruments, Mannheim, Germany, July 2010, Hands on Linz winter school "Advances in Single Molecule Research for Biology & Nanoscience", Linz, Austria, February 2011. She will further specialized in single molecule force spectroscopy.

Tea Mišić Radić
research assistant, at RBI since 2005
B. Sc. chemistry
Doctoral study in chemistry – physical chemistry
PhD thesis: ***Supramolecular organization of marine gel biopolymers studied by atomic force microscopy*** - October 2010
AFM training, 1st AFM BioMed Summer School, Bagnols sur Ceze, France, 2008; Advanced Polymer training, Veeco Instrumens, Santa Barbara, CA, USA, 2007

Amela Hozić Zimmermann
senior assistant, at RBI since 2001
B. Sc. chemical engineering and technology
Graduate Studies in Engineering Chemistry
PhD thesis***: Electrochemical sensor for detection of soft particles*** (2007)
2002 Universite P. et M. Curie, Paris 6, Laboratoire d'Electrochimie, CNRS, Paris, France; 2010 Institute Curie, Simon, naomechanical properties of living cells by AFM

Nadica Ivošević DeNardis
research associate, at RBI since1993
B.Sc. chemistry; M.Sc. oceanography; Ph.D. chemistry
PhD thesis**: *Wetting and spreading of organic droplets at a charged, conductive interface*** (1997)
Fulbright postdoctoral fellowship, Dept. of Marine Sci., Univ. of Connecticut, 1999-2000; fellowship, Dept. of biochem., biophys. and chem. macromolecules, Univ. of Trieste, 2002

Suzana Šegota
research associate, at RBI since 2007
Ph.D. chemistry
PhD thesis: Fractal Clusters of Association Colloids
Karl-Franzens University, Institute for Physical Chemistry, Graz, Austria, 1994/1995

Vera Žutić
senior scientist, at RBI since 1963, retired 2005
Head of the Laboratory for Ecological Modeling 1995-2005
Interfacial processes and bioelectrochemistry for marine systems
Teaching: Oxidation-reduction processes in the sea; Marine organic matter organization and function, *Interdisciplinary Doctoral Study in Oceanography*

Technical staff:
Marija Hibić, at RBI since 1992

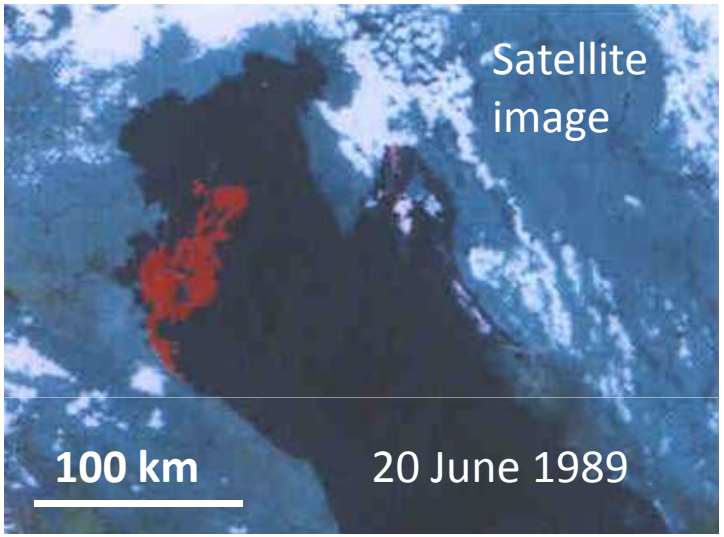
Activity

Fundamental research in the field of marine ecology at nanoscale introducing imaging techniques of atomic force microscopy (AFM).

The potential of AFM in studying organic matter in the sea has not been previously utilized.

Marine ecology at nanoscale

Northern Adriatic giant gel phase



Major component: carboxylated and sulfonated heteropolysaccharides

Formation mechanism largely unknown

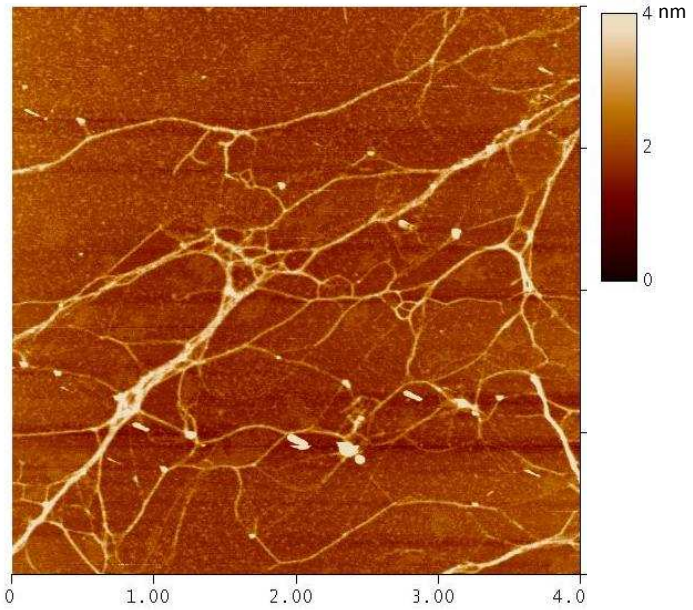
Our focus: marine gel network formation

Episodes studied: 2000, 2001, 2002, 2003, 2004

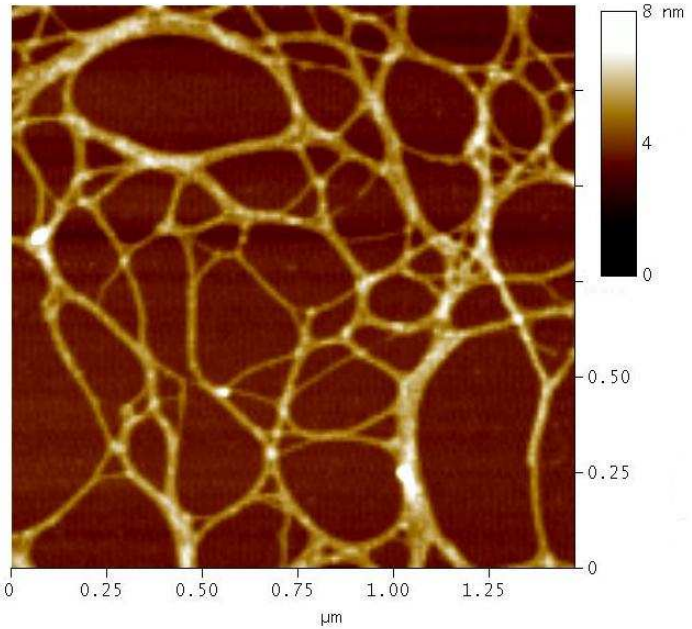
evolution of giant gels at the nanoscale imaged by AFM

field data

early stage of gel formmation

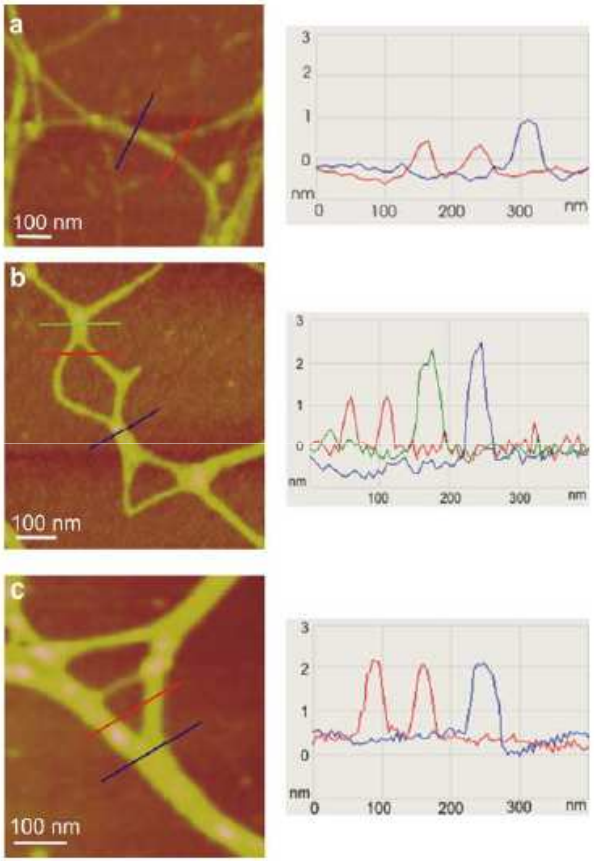


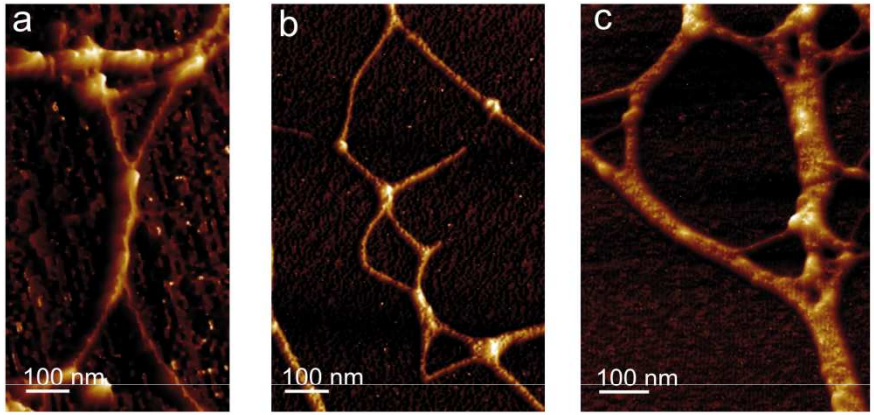
mature gel network



Marine gel sample deposited on mica

structural details of the gel network at molecular resolution

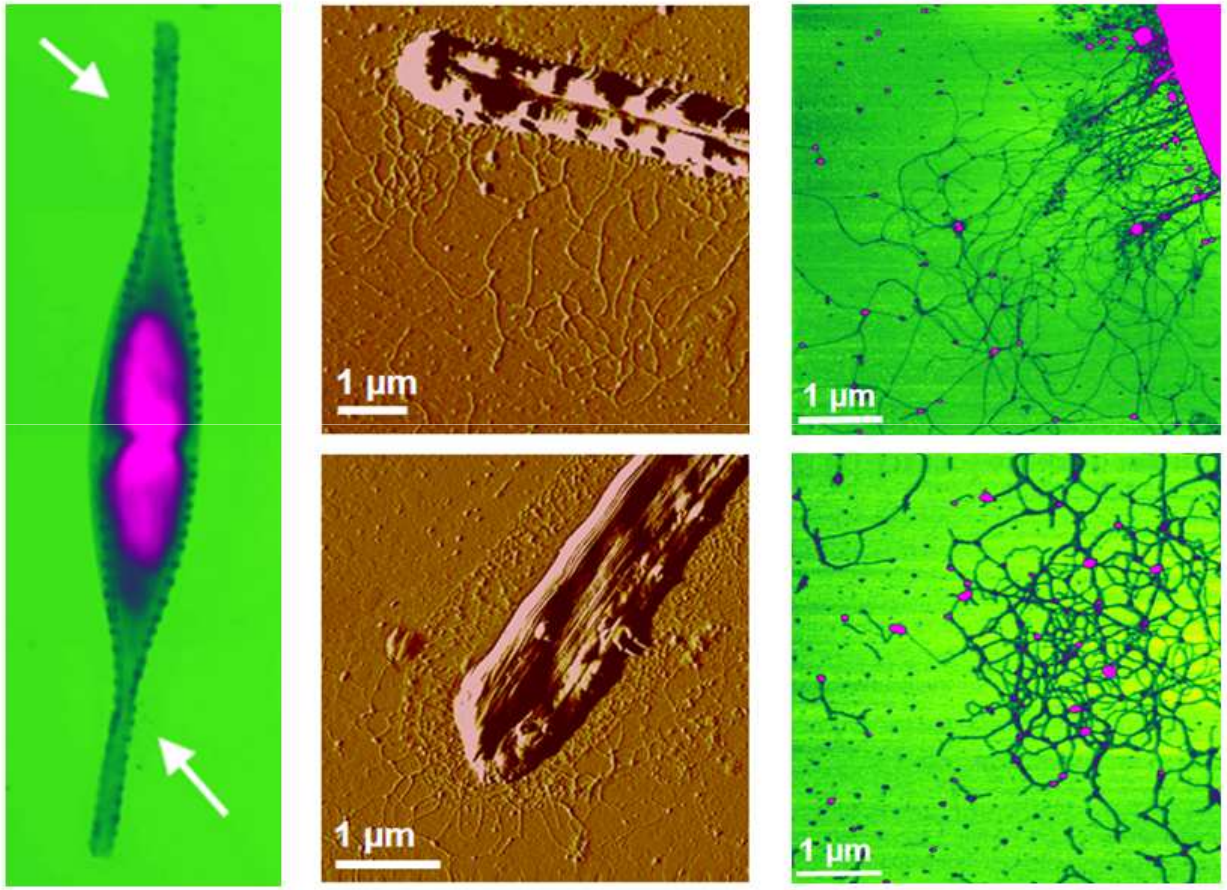




The fibril associations are presented as topographical AFM images with characteristic vertical profiles of fibrils forming junction zones.

T. Mišić Radić et al. Seawater at the nanoscale: marine gel imaged by atomic force microscopy. *J. Mol. Recognit.* (*2011)*

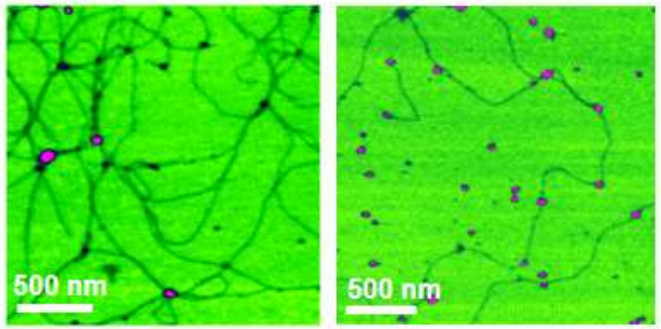
AFM imaging of extracellular polymer release by marine diatom



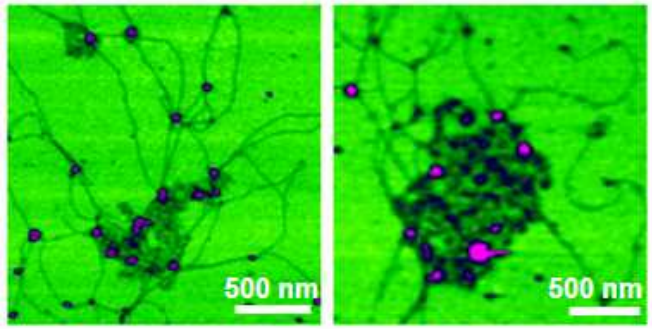
G. Pletikapić et al. AFM imaging of extracellular polymer release by marine diatom *Cylindrotheca closterium* *J. Mol. Recognit. 2011*, Svetlicic et al. Polymer Networks produced by Marine Diatoms in the Northern Adriatic Sea *Marine Drugs*, 2011

structural organization of the extracellular polymers

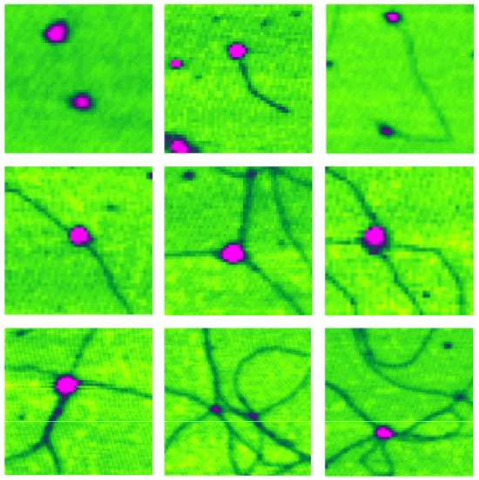
Fibrillar network

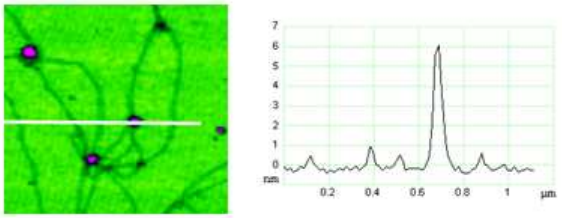


Patches of compact form in fibrillar network



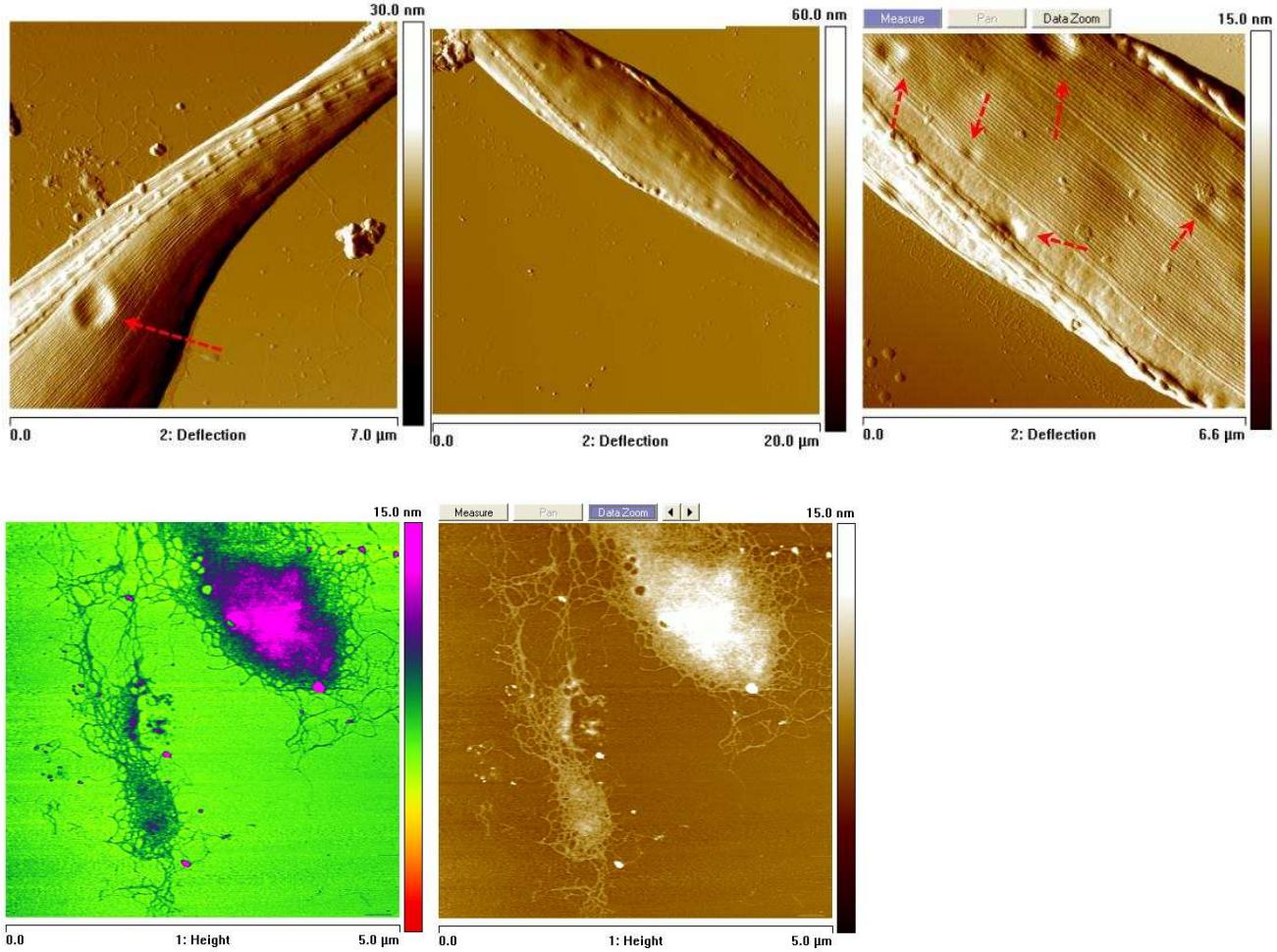
Fibril - globule interconnections





globules may represent positively charged proteins

marine diatom and silver NP



WG 4

Environmental Nanotoxicology and Nanoparticles

the competence of AFM to study the toxicological properties of engineered nanoparticles in our environment or in ecologically relevant organisms

The gathered experience and developed protocols will help to evaluate the use of AFM as a tool in nanoecology and nanoecotoxicology for marine environments.