

Multifunctional Conservation Technologies for preservation of paper carriers of information

Katarína Vizárová, Radko Tiňo



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 - *M – multi-factorial degradation processes*
 - *C – conservation as a summary of the technological processes*
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- Recent praxis in conservation
 - *Individual technologies for individual problems*
 - *Deacidification technologies*
- Our research and solution proposal
 - *Safe Aqueous Technology (SAT)*
 - *Plasma treatment technology*



Slovak University of technology in Bratislava

Faculty of Chemical and Food Technology

Institute of Natural and Synthetic Polymers

Department of Plastics, Rubber and Fibres

Department of polymer processing

Department of Wood, Pulp and Paper

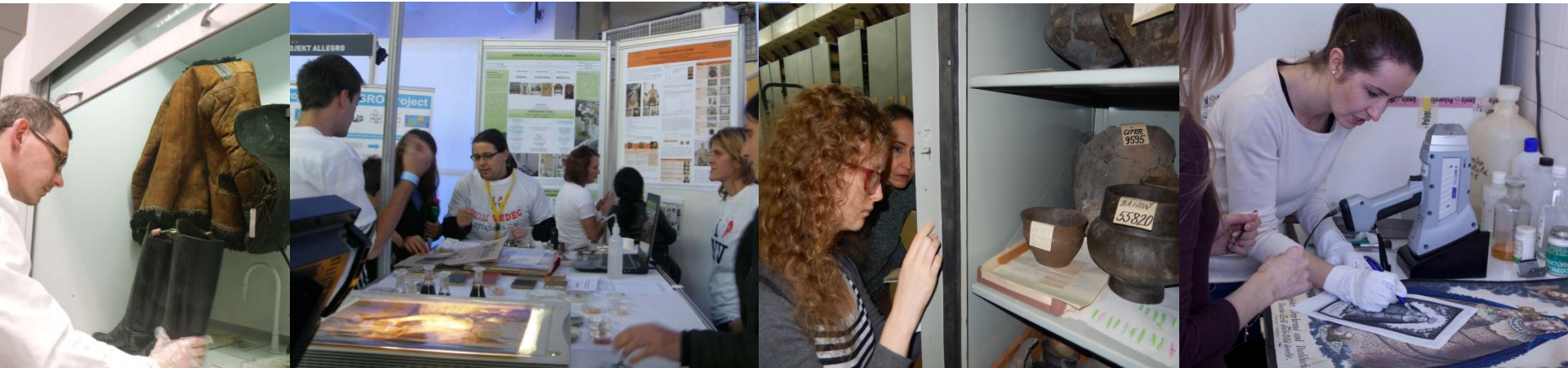
Department of Graphic Arts Technology and Applied Photochemistry



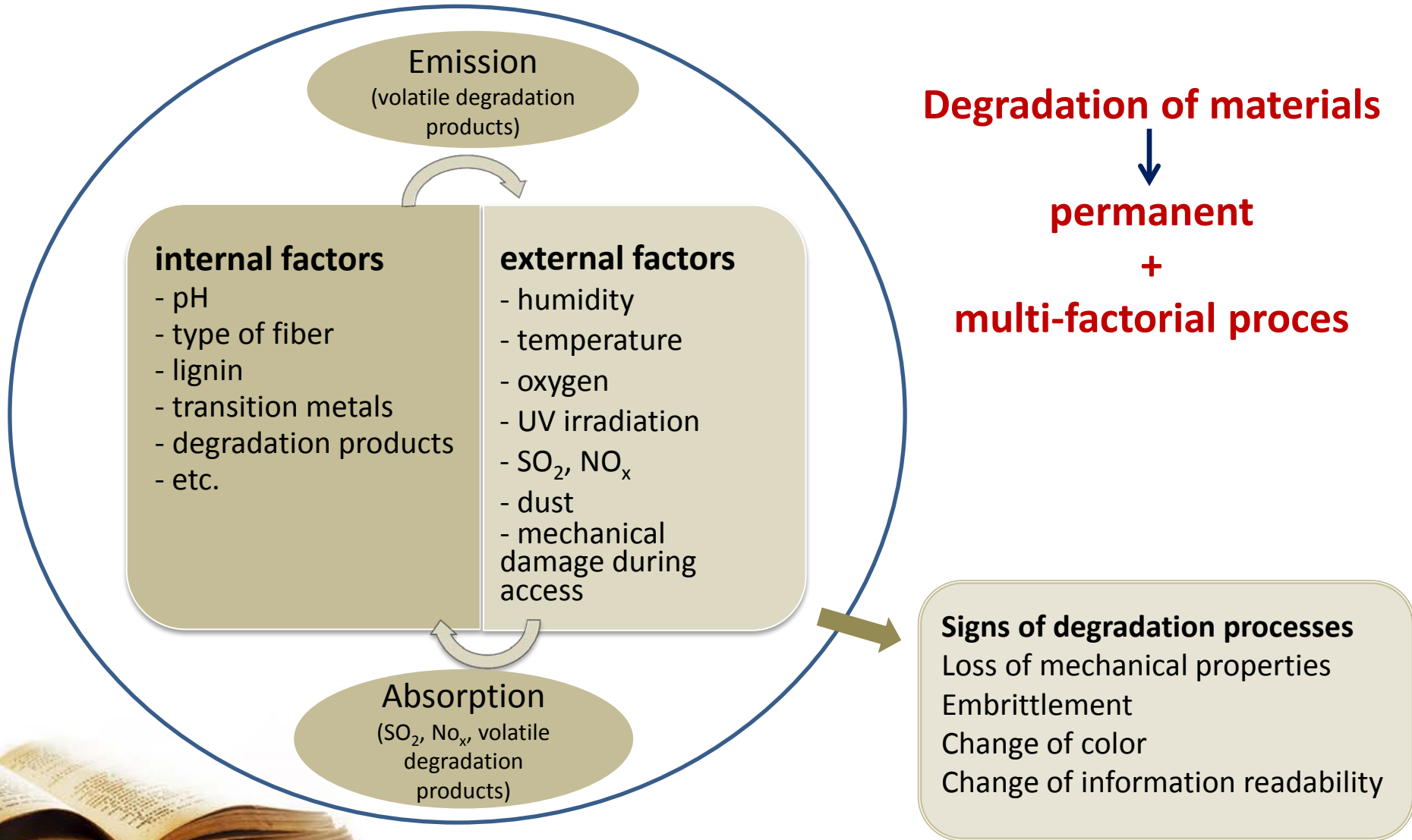
Conservation of Heritage Materials and Objects

Research and Education

Interdisciplinary cooperation



Multifactorial aging of paper carriers of information

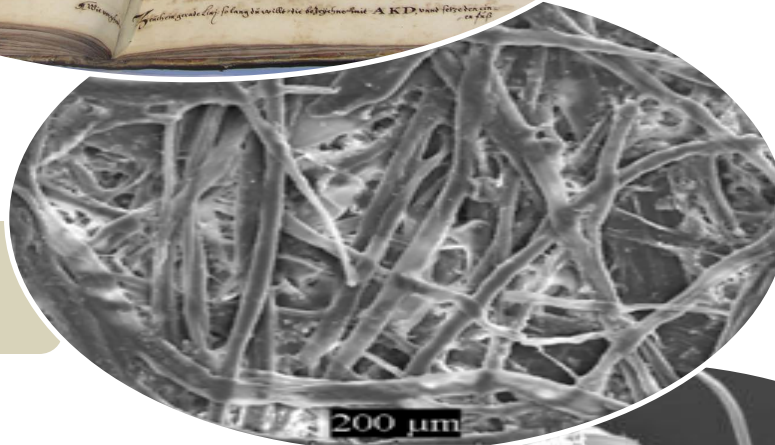


Paper carriers of information

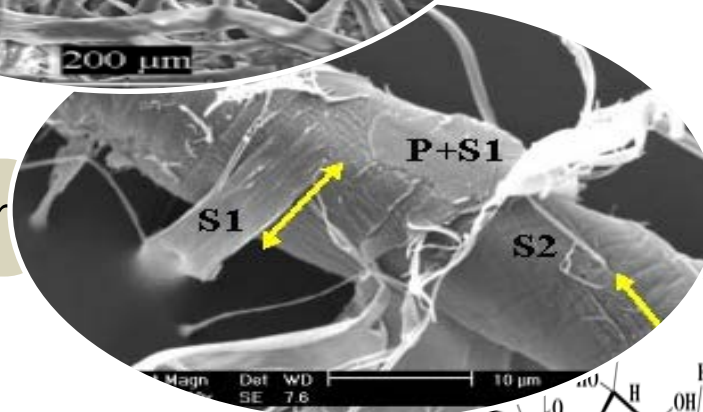
Book



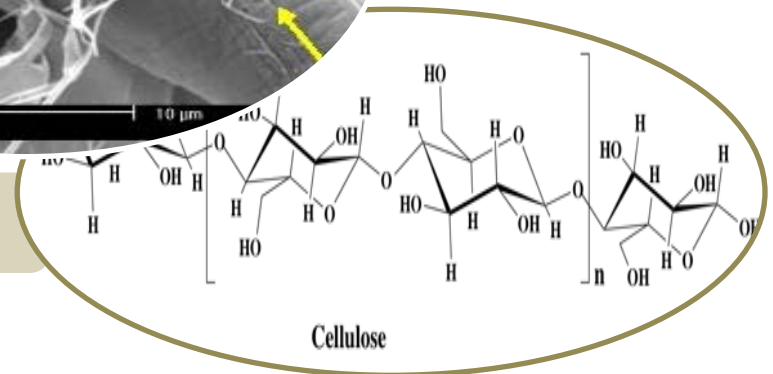
Paper



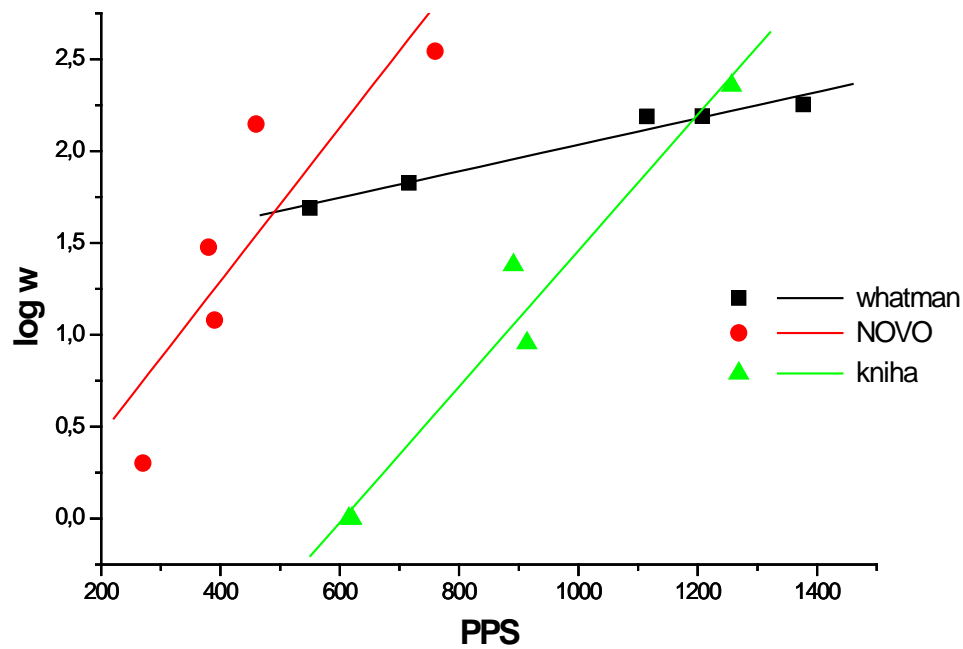
Papermaking fiber



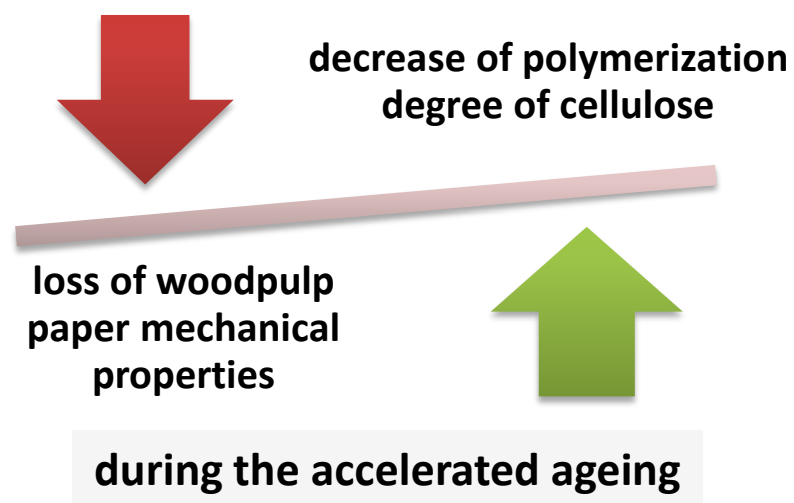
Cellulose



Consequences of paper degradation processes



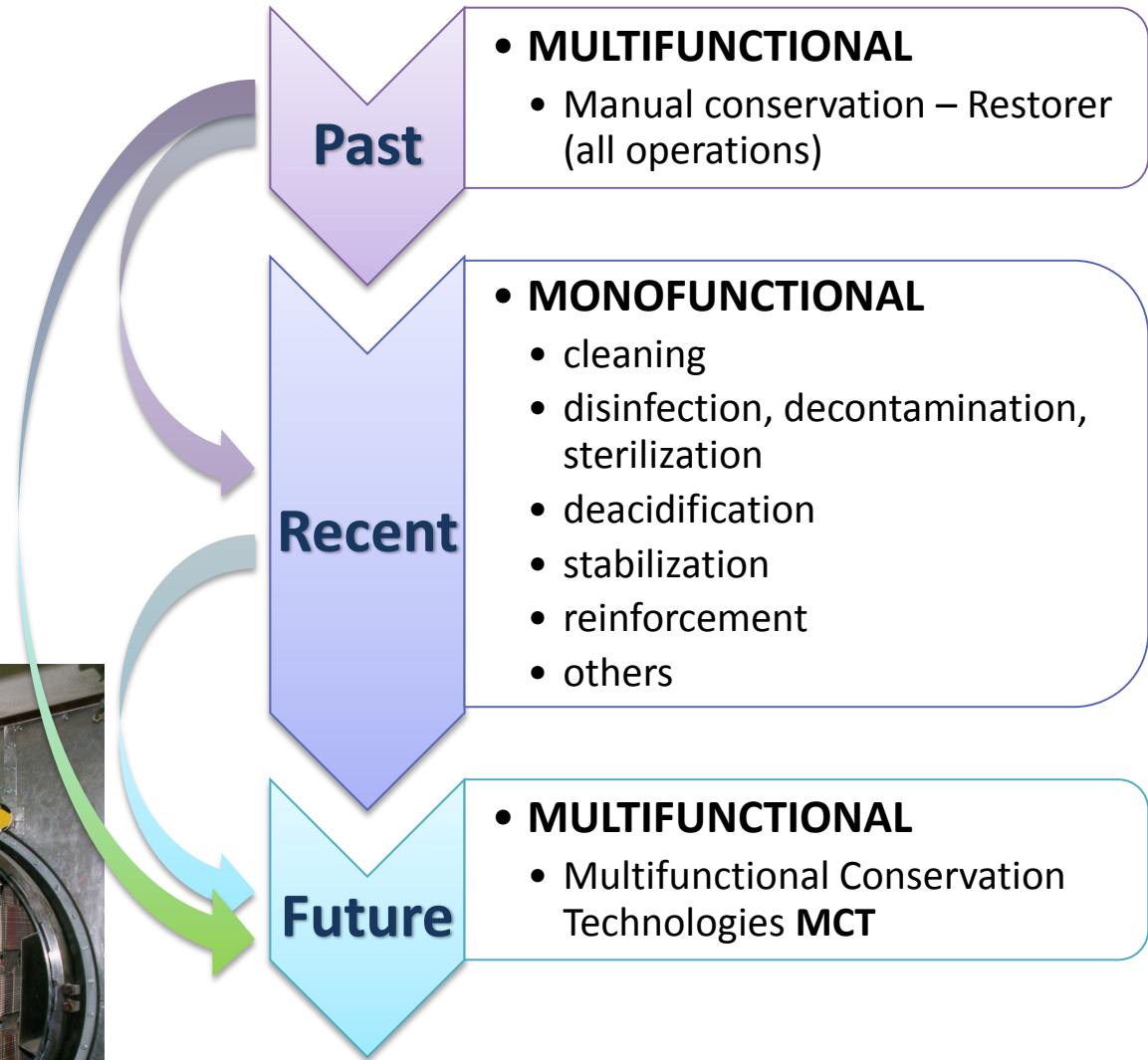
RELATIONSHIPS BETWEEN



paper	r	p-value
Whatman	0,98	0,002
NOVO	0,88	0,052
kniha	0,98	0,003



Conservation Technologies



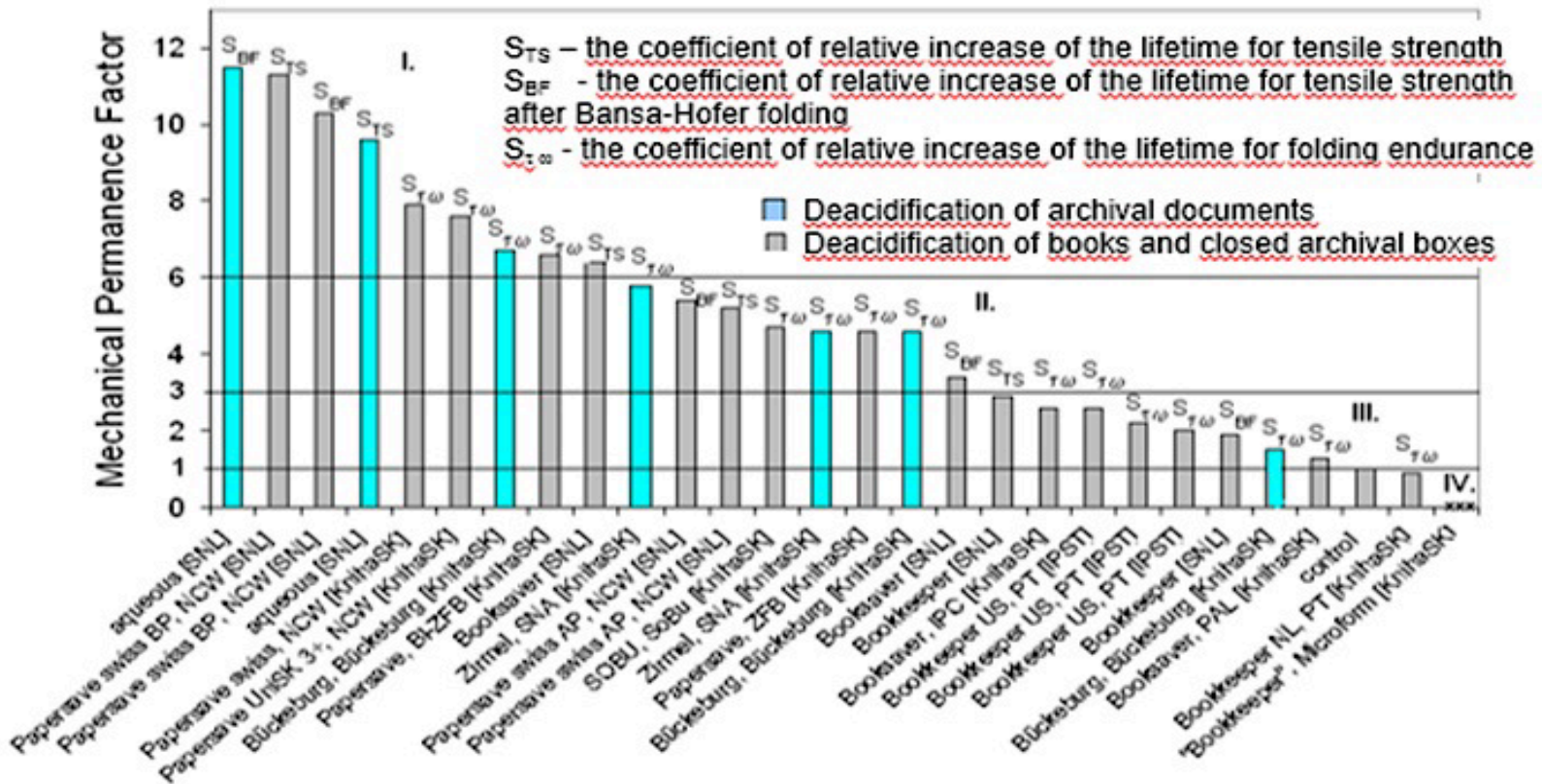
Quantification of the problem

- The current conservation practice still deals with serious issue which is presence of acids in the paper, causing fast degradation of pulp fibers in the most endangered books and documents on acid paper, which make up 80-85% of the resources of libraries, archives and other world heritage institutions
- Statistical data (2010) in SR

Druh kultúrnych objektov (KO)	Počet KO SR 2009 (počet KO v SR za rok 2009)	Ročný prírastok KO (počet KO/rok)	Ročný výkon konzervovania, reštaurovania, zdigitalizovania z celkového počtu KO SR v roku 2009. (%/ rok)	Potreba ochrany, konzervovania, zdigitalizovania KO (%)
archívne dokumenty	1 000 000 000	50 000 -150 000	0,0001 – 0,0002	99,9999-99,9998
textové analogové dokumenty	5 000 000	5 000 -15 000	0,076 – 0,237	99,924 -99,763
2D objekt + malý 3D objekt + veľký 3D objekt	15 904 143	100 000 – 300 000	0,63 – 1,26	99,37-98,74

Evaluation

Slovak project Kniha^{SK} – Comparative evaluation of deacidification processes¹ Priority is longevity²



1. Katuščák, S., Jablonský, M., Holúbková, S.: Comparative Evaluation of Deacidification Processes. [ed.] Mälck A., Niggemann E., Pothast A., Schneider-Kempf B. Altenhöner R. Blüher A. *EINE ZUKUNFT FÜR SAURES PAPIER. Perspektiven von Archiven und Bibliotheken nach Abschluss des KUR-Projekts „Nachhaltigkeit der Massenentsäuerung von Bibliotheksgut“* Zeitschrift für Bibliothekswesen und Bibliographie Sonderbände. Zv. 106, p. 149-176, 2012.
2. Drewes J., France, F.: Taking the measure: Treatment and Testing in Mass Deacidification. The Book and Paper Group Annual 31, p. 104, 2012. *Mass Deacidification Today. Open discussion on May 11th, 2012, the 40th AIC Annual Meeting in Albuquerque, New Mexico*

Comparative evaluation of deacidification processes – by KnihaSK

BAT

Papersave Swiss > Papersave > CSC Booksaver > SOBU > Bookkeeper

technologically
difficult

least efficient

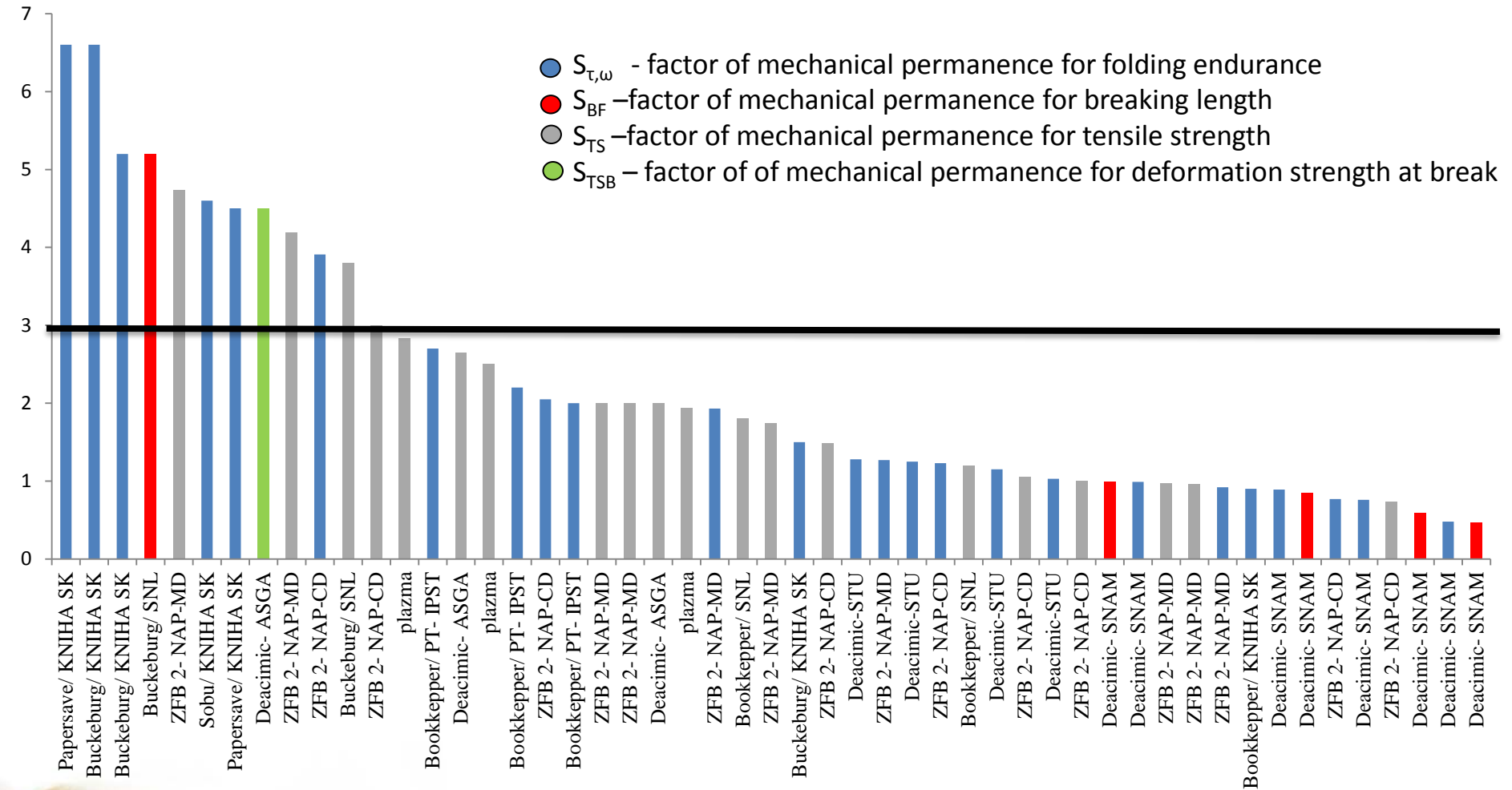
the most widespread!

efficiency problems

incomplete
deacidification



Comparative evaluation of deacidification processes – updated in 2016



Comparison of independent studies testing the mechanical permanence factors efficacy



The Recent problems

- Testing parameters for mass deacidification should be standardized across the board for all the various processes
- Testing should be conducted by independent researchers (not manufacturers or vendors!) – objective testing
- There is *no* one best, **optimal** process for deacidification paper carriers of information in the world.
- so far commercially developed and implemented process has its **advantages** and **drawbacks**.
- Even, **if it was optimal**, it still has flaws – it's **mono-functional!**

The Future of efficient Mass Conservation Technology

- multi-threat protection - development of Multifunctional Conservation Technology (MCT)
- set of all conservation technologies



We propose

- **DEVELOPMENT of MULTIFUNCTIONAL Conservation Technologies (for conservation of books and documents);**
- **environmentally friendly and effective technologies;**
- complete removing / elimination of degradation factors, applied on base of initial quality control:
 - **Safe Aqueous Technology (SAT)**
 - **Plasma treatment technology**



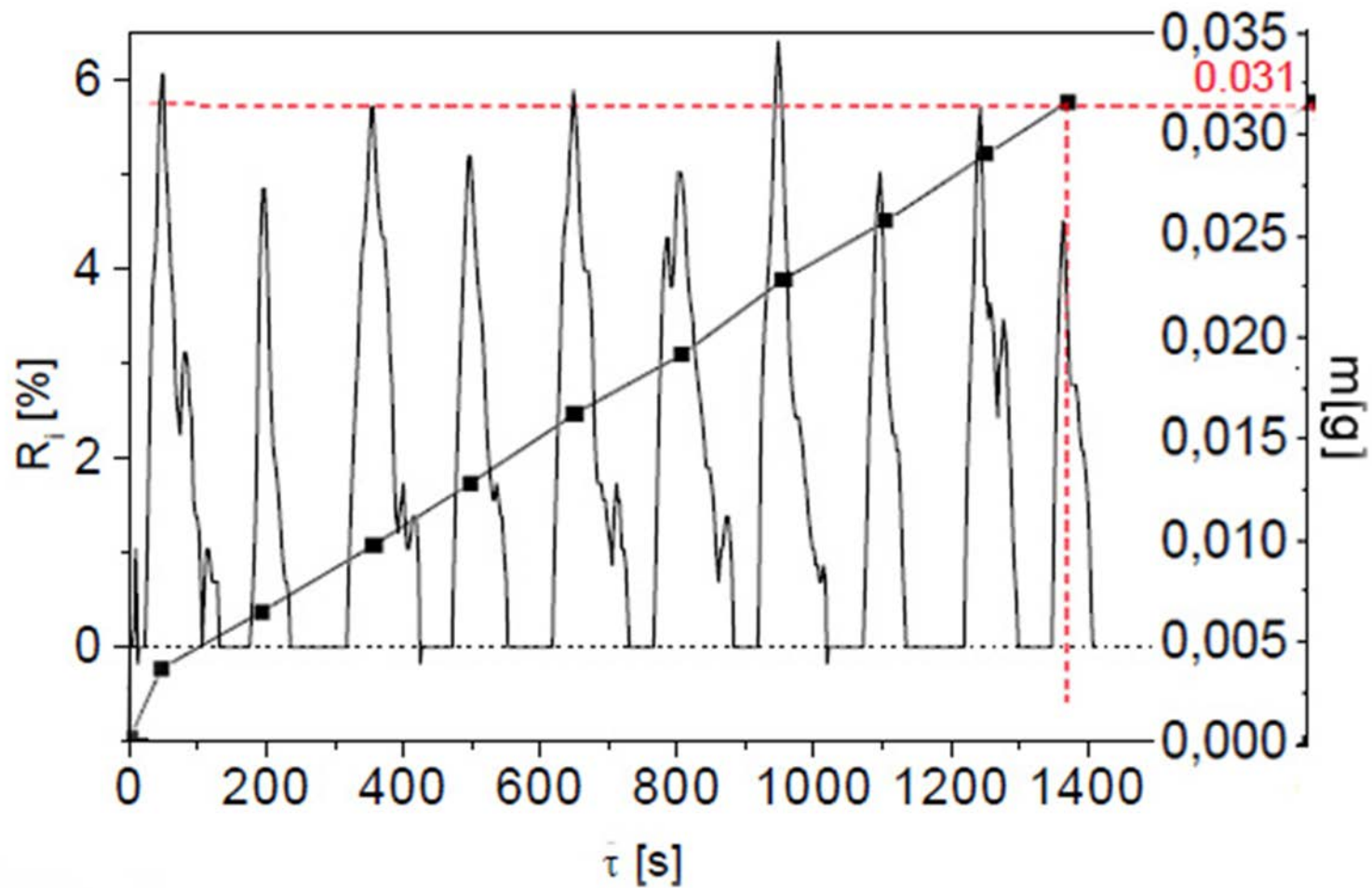
DEVELOPMENT of MULTIFUNCTIONAL Conservation Technologies (for conservation of books and documents)

- **Safe Aqueous Technology (SAT):**
 - **INNOVATION of existing and DEVELOPMENT of new deacidification processes**
 - **perspective of using the most suitable environment for effective modification – based on water – suitable for further R&D**
 - **Solutions of STU (patents and other outputs -) suitable fortreatment of books and blocks of paper without deformation and damage is now possible = SUBDEFORMATIONAL DEPOSITION**
 - **Our new US patent (Vizarova at al. 2016) offers solutions for completing of deacidification and also allows application of the principles of multi-threat protection in a single device.**



World knows, that paper cannot be submerged into the **water** without consequences (damage).





Technological conservation Centre at Faculty of Chemical and Food Technology STU in Bratislava



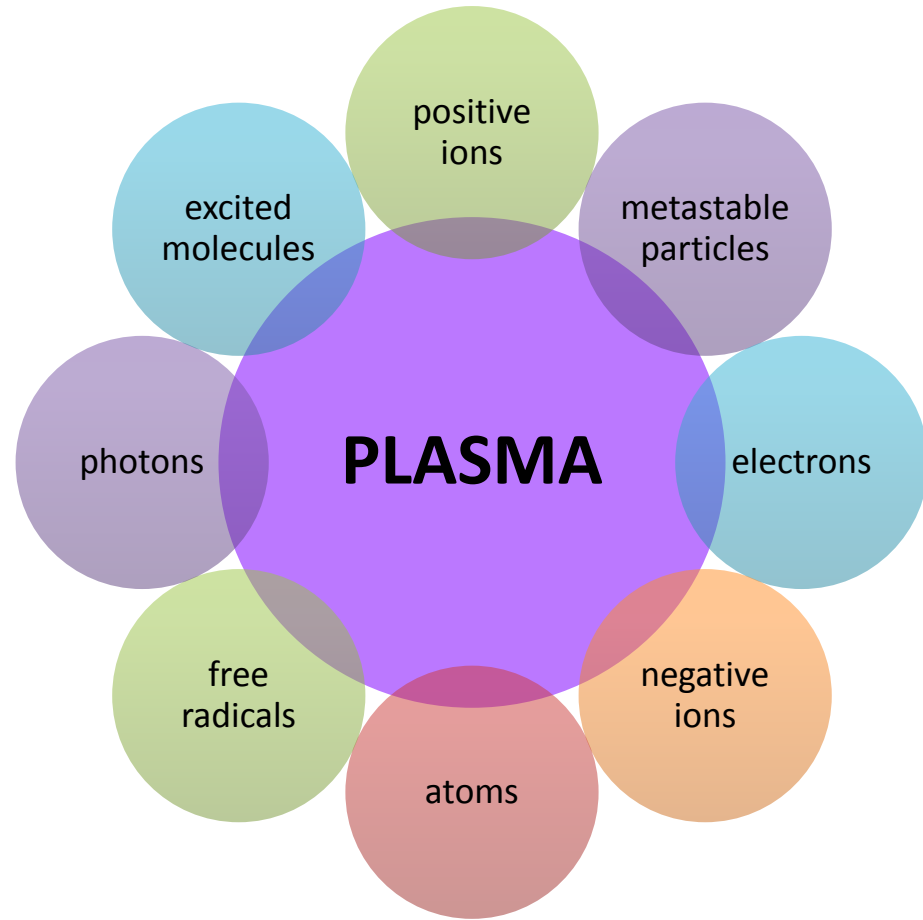
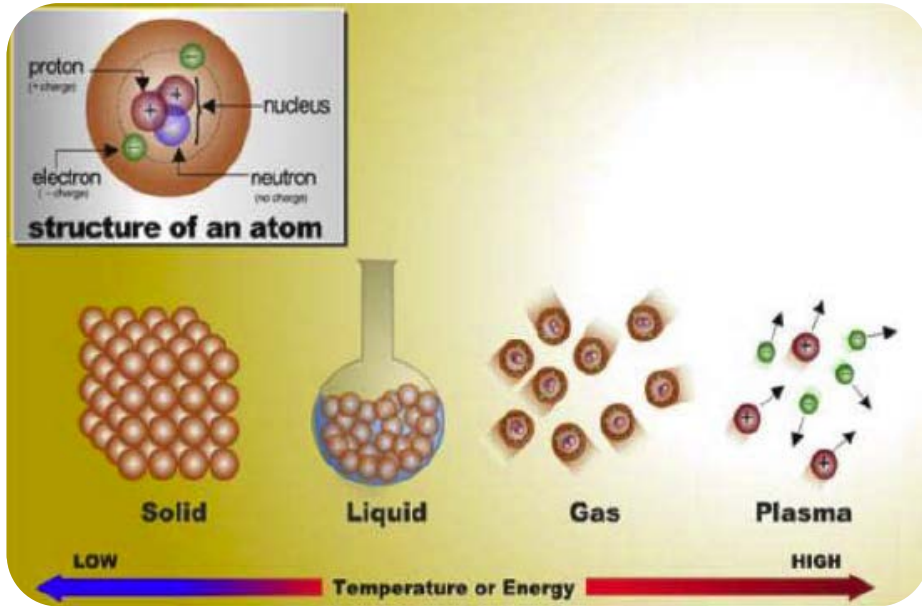




We propose

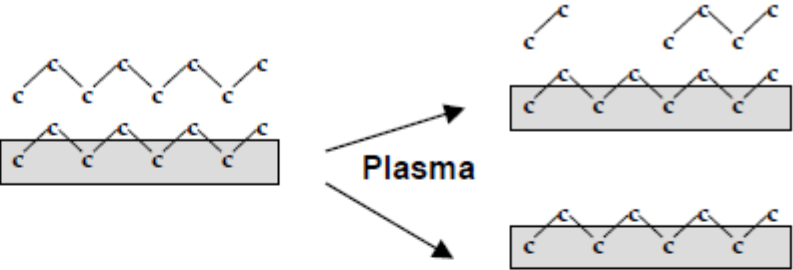
Future

DEVELOPMENT of MULTIFUNCTIONAL Conservation Technologies (for conservation of books and documents ... and others) - Plasma treatment

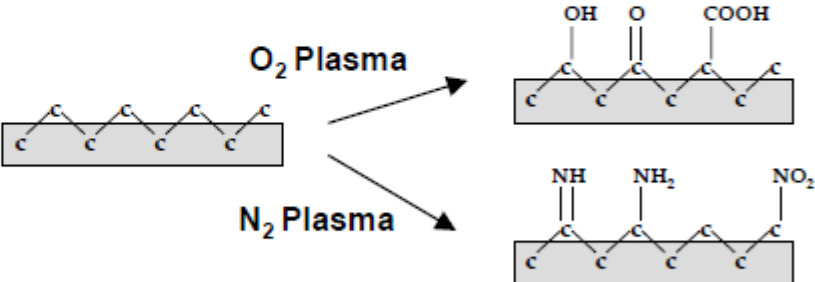


Plasma treatment technology offers

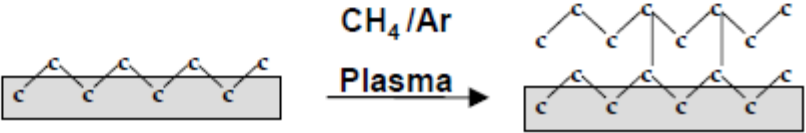
Cleaning, etching and sterilisation



Activation



Coating



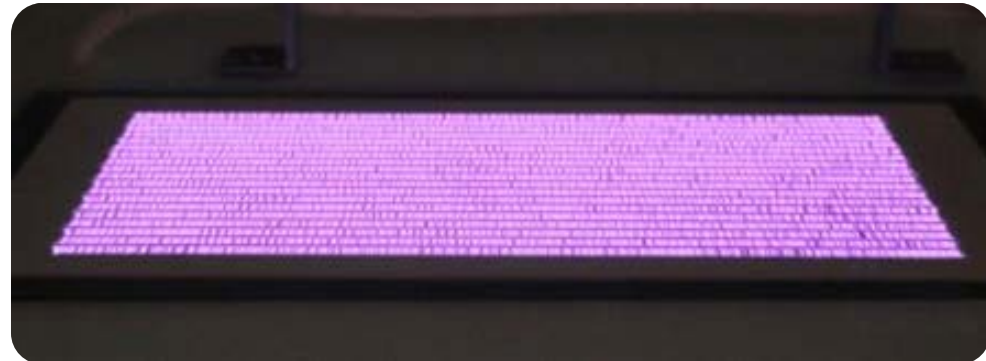
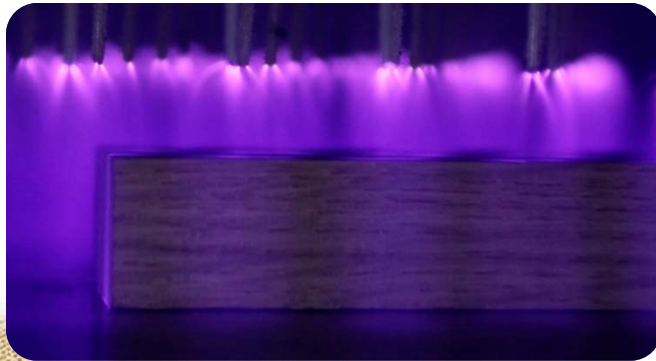
+



- sterilization / decontamination

traditional sterilization	plasma sterilization
heat	reactive chemical species
UV Light	UV Light
toxic agents	heat
	electric field

- ✓ non-toxic, multifunctional, energetically and cost efficient, environmentally friendly
- ✓ cold plasma is suitable for **treatment of biomaterials**
- ✓ during the plasma treatment, simultaneous synergic effects take a part



Preliminary experiment

sterilisation of microorganisms in low temperature plasma discharge

- **papier:**
Whatman
- **inokulum:** *Penicillium chrysogenum*,
- **ADRE plazma:**
E = 1.24 J,
E = 0,6 J (30min),
- **plyn:** O₂,

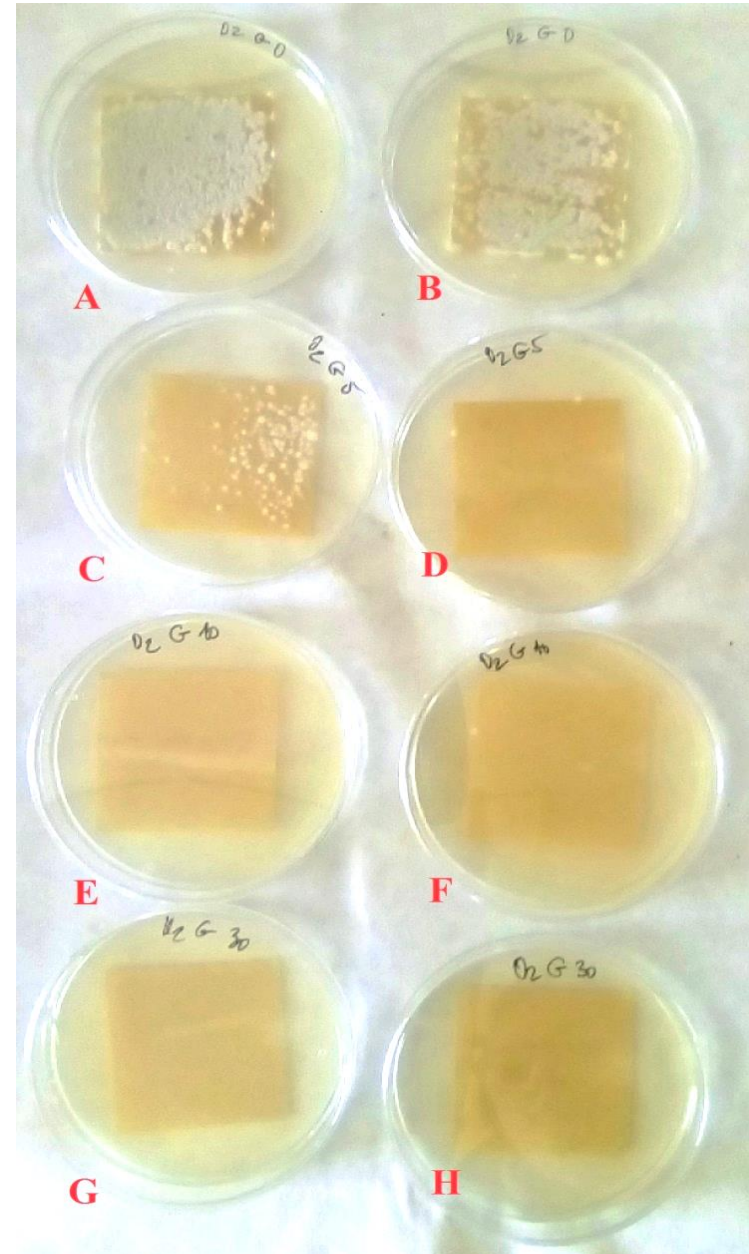
čas:

A, B (0 min),

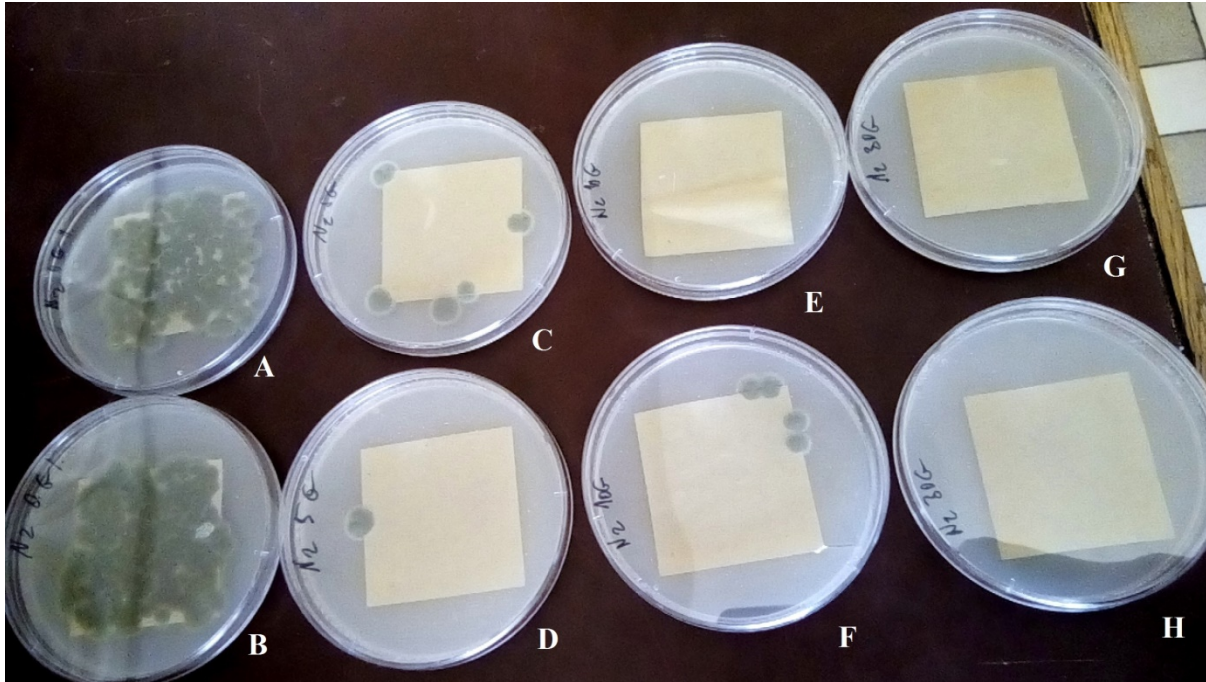
C, D (5 min),

E, F (10 min),

G, H (30 min)



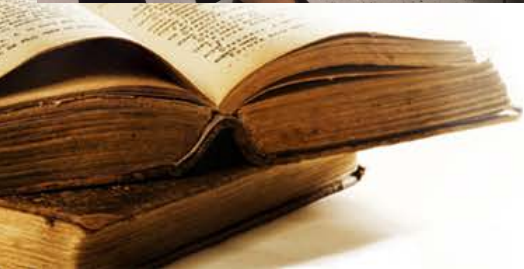
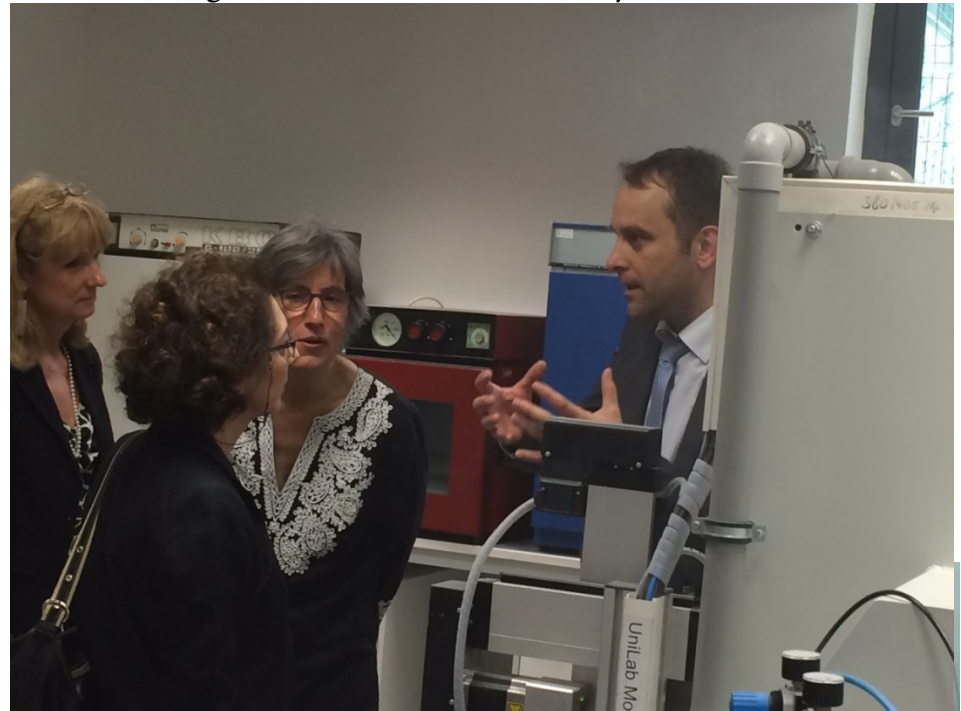
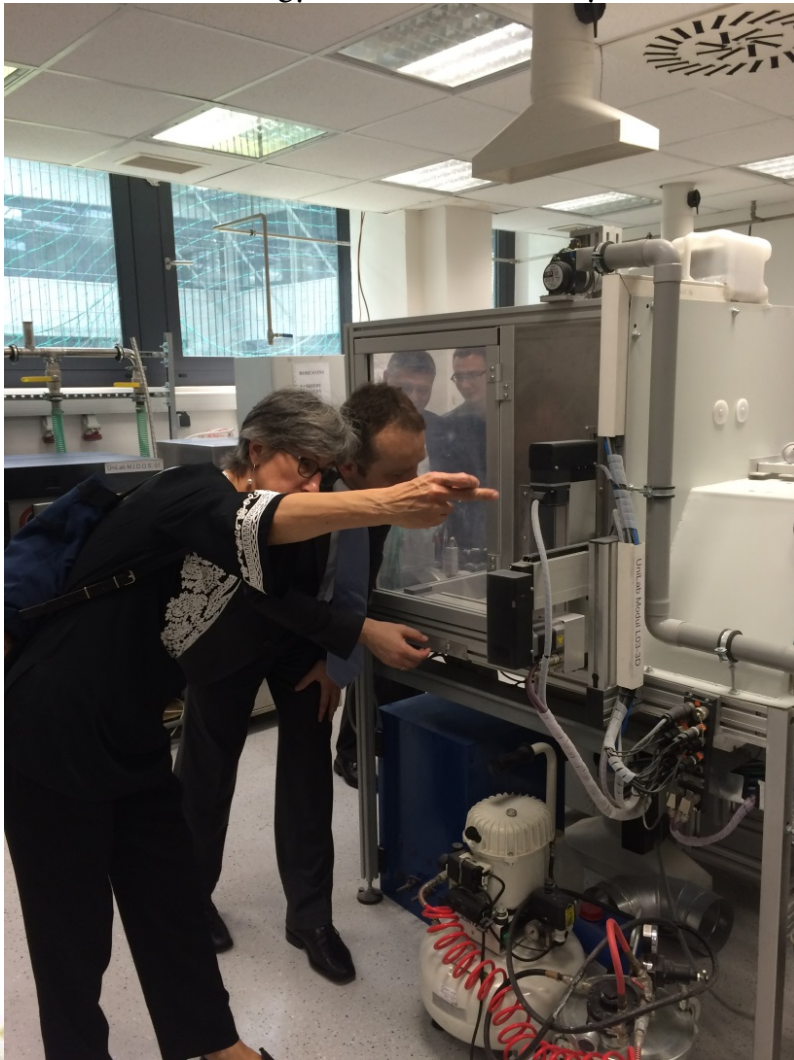
Preliminary experiment samples of microorganisms colonising paper substrate sterilised in plasma discharge



papier: glejený, **inokulum:** *Cladosporium Herbarum*,
ADRE plazma: E = 1.24 J, E = 0,6 J (30 min), **plyn:** N₂,
čas: A, B (0 min), C, D (5 min), E, F (10 min), G, H (30 min)



Flavia Schlegel - Assisten Director General (ADG) for the natural sciences UNESCO visiting Faculty of Chemical and Food Technology Slovak University of Technology and its Technological Conservation Centre (june 2016).



Thank you for your Attention

Acknowledgement

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