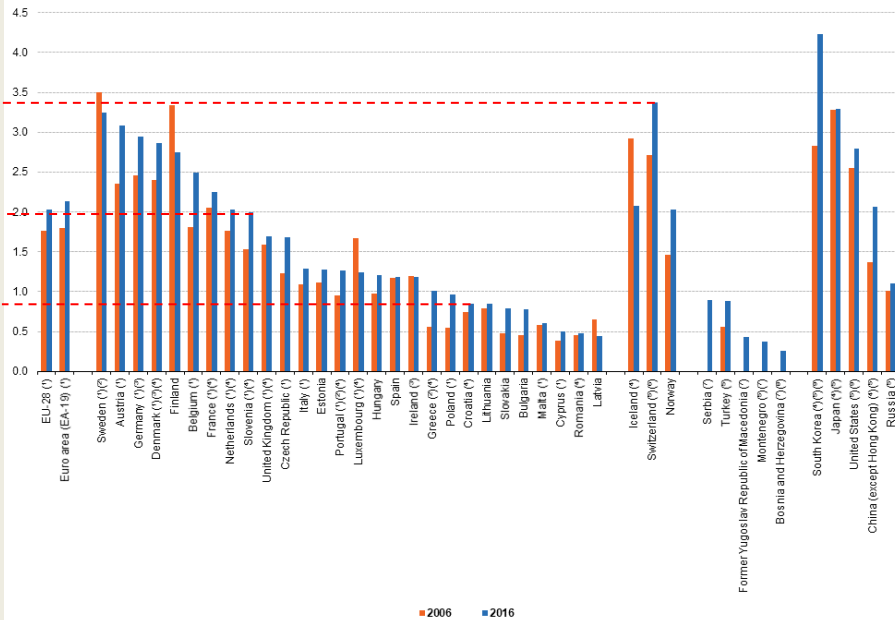




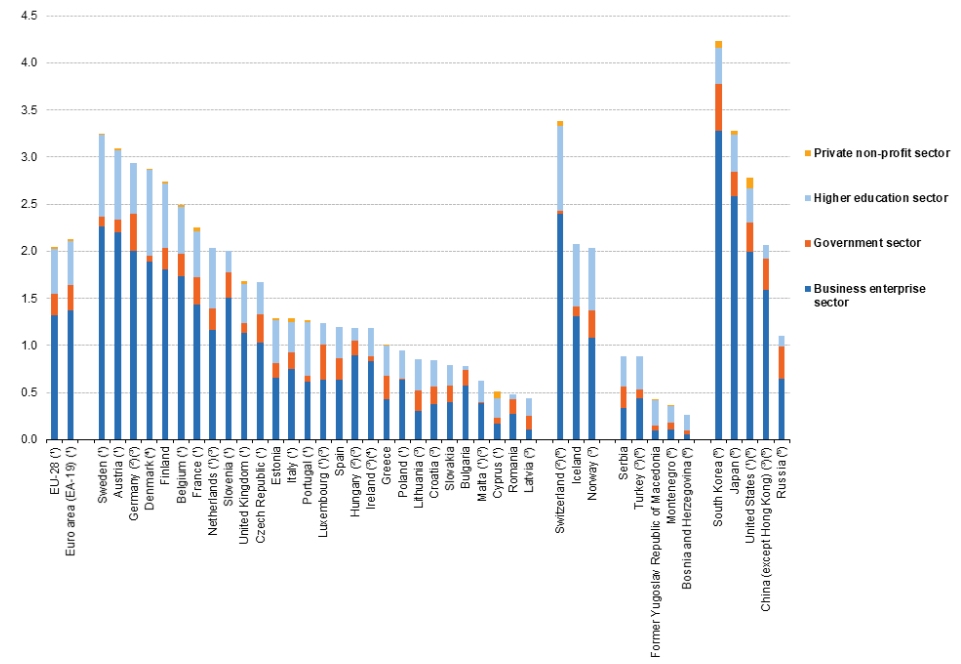
Znanstvena infrastruktura –
osnova za istraživanja, poticanje inovacija i
suradnju s gospodarstvom

Marijana Serdar

Ulaganje u znanost



Note: when definitions differ, see http://ec.europa.eu/eurostat/cache/metadata/en/rd_esms.htm.
 (*) 2016: provisional.
 (Y) 2006: estimate.
 (Y) 2016: estimate.
 (*) Break in series.
 (Y) 2015 instead of 2016.
 (Y) 2008 instead of 2006.
 (Y) 2006: not available.
 (Y) 2014 instead of 2016.
 (Y) 2006: definition differs.
 Source: Eurostat (online data code: rd_e_gertdot)



Note: when definitions differ, see http://ec.europa.eu/eurostat/cache/metadata/en/rd_esms.htm.
 (*) Provisional.
 (Y) Definition differs.
 (Y) Private non-profit sector: not available.
 (Y) Estimates.
 (Y) 2015.
 (Y) 2014.
 Source: Eurostat (online data code: rd_e_gertdot)

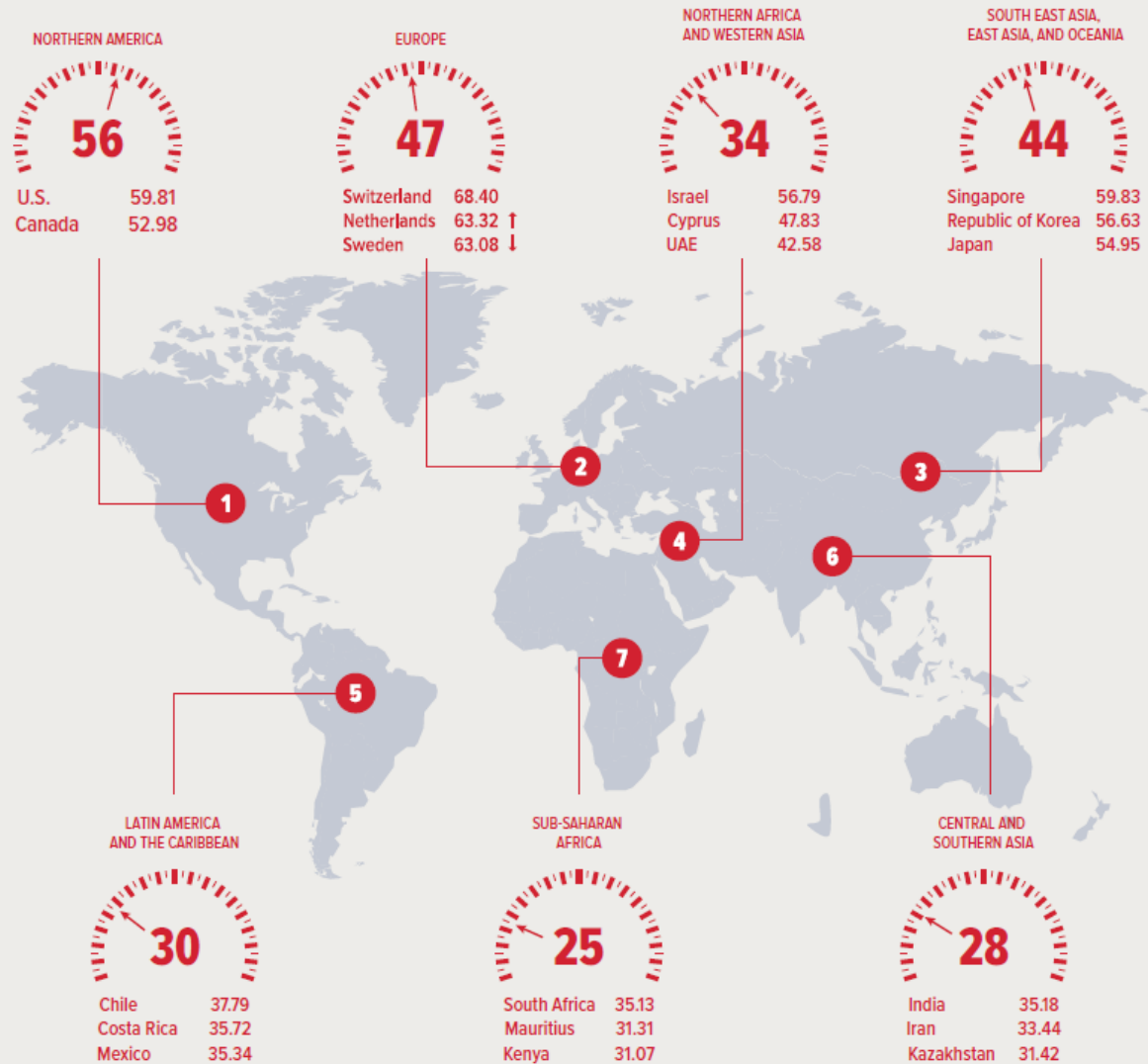


Lideri u inovacijama

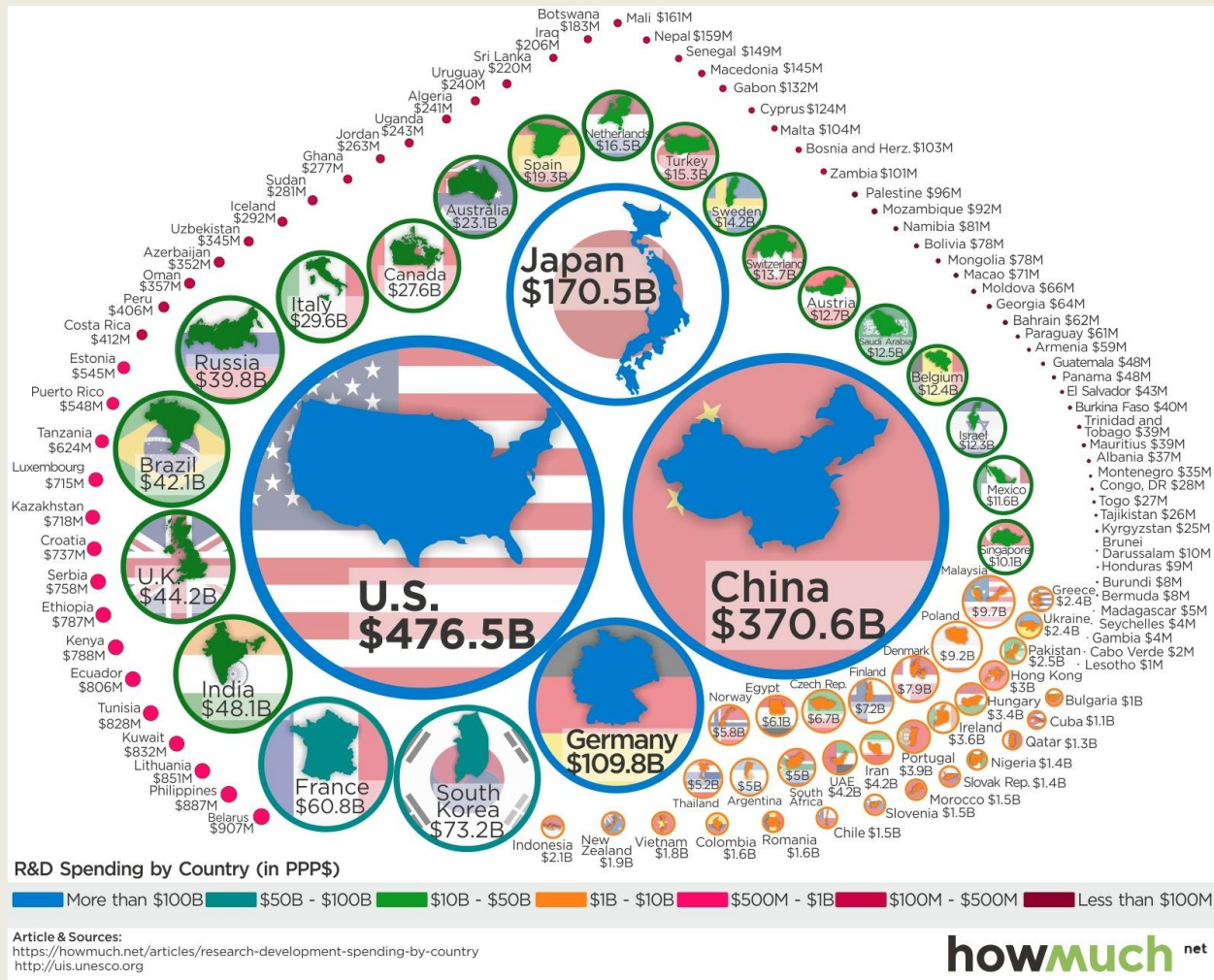


Soumitra Dutta, Bruno Lanvin, and Sacha Wunsch-Vincent GLOBAL INNOVATION INDEX 2018 Energizing the World with Innovation

Top Innovation regions by GII score



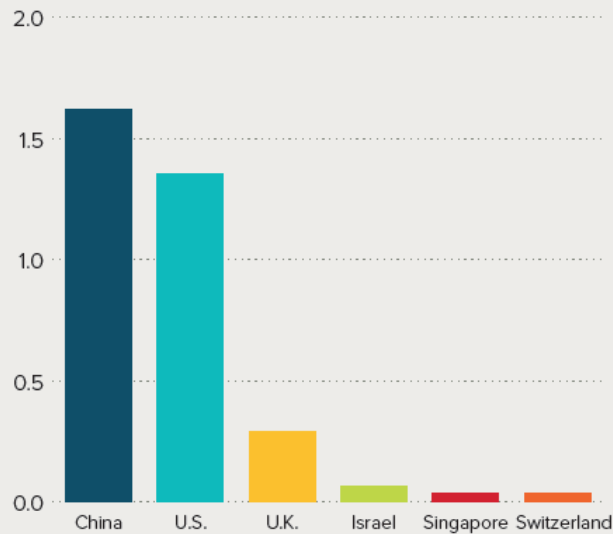
Ulaganje u znanost



Istraživači – patenti - publikacije

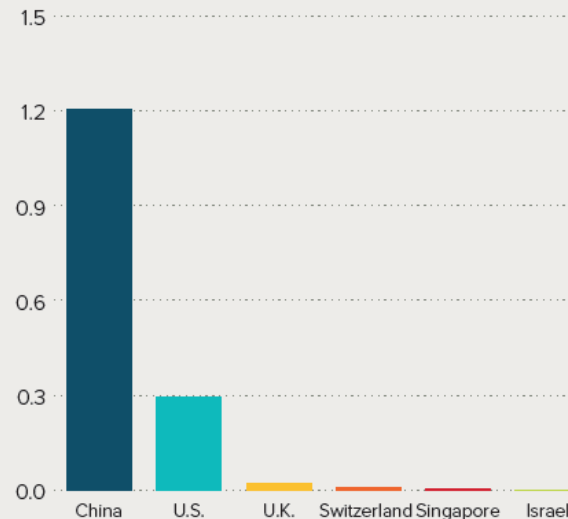
Researchers, 2015 or latest year available

Number of researchers, millions



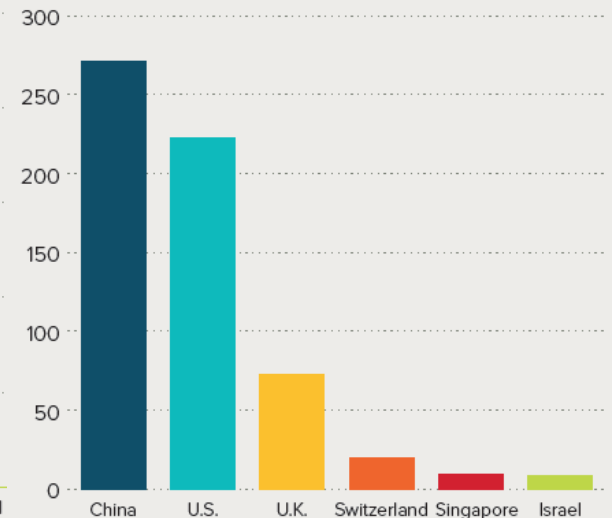
Patents by origin

Number of applications, millions

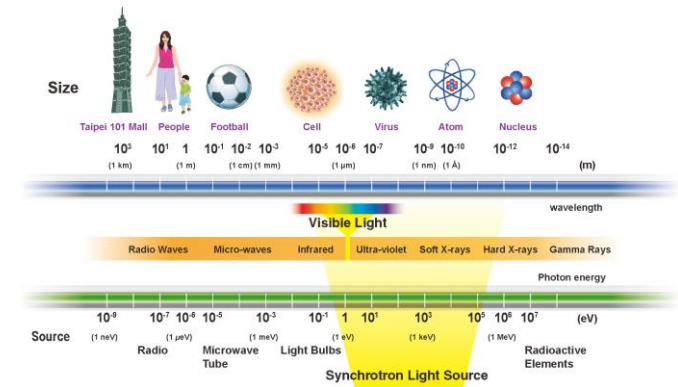


Scientific and technical publications, 2017

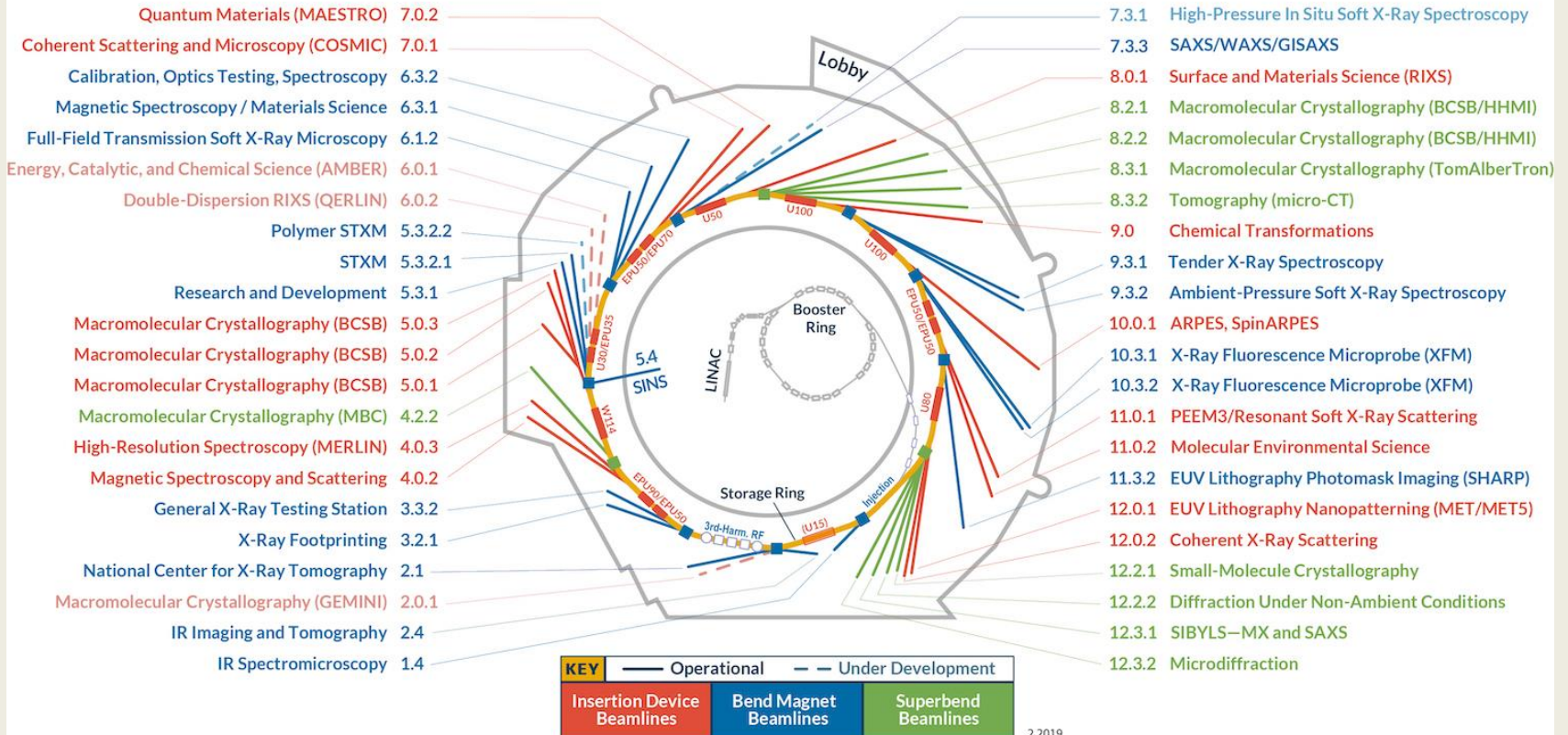
Number of publications, thousands



Istraživačka infrastruktura primjer sinkrotrona



ALS Beamlines



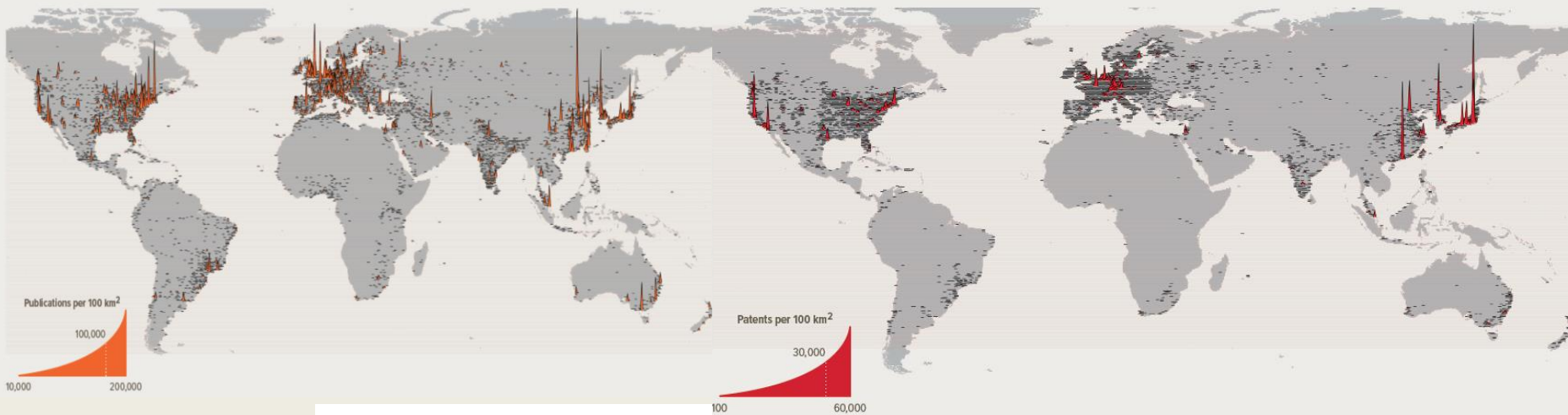
<https://www.nsrrc.org.tw/english/lightsource.aspx>

<https://als.lbl.gov/beamlines/>

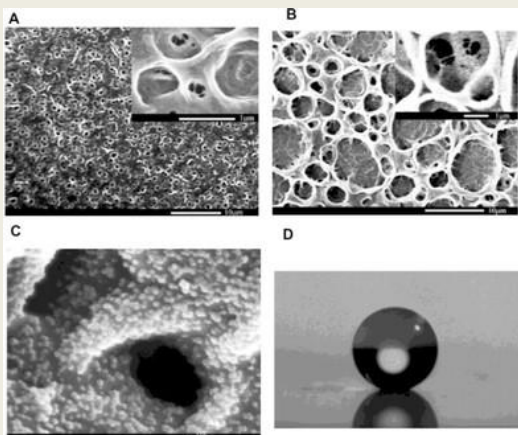


Publikacije u svijetu

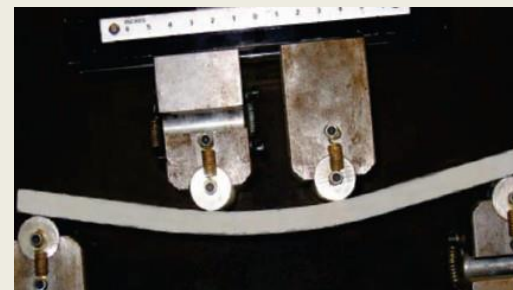
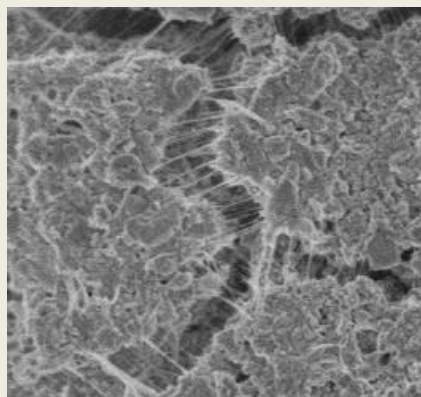
Patenti u svijetu



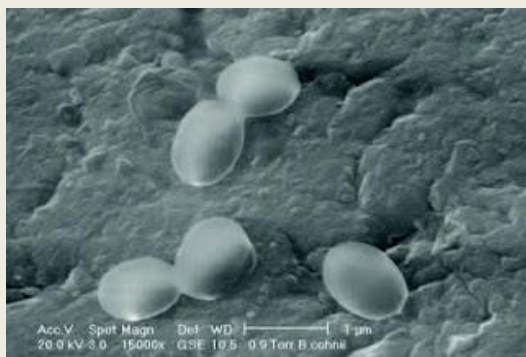
Važnost znanstvene infrastrukture u istraživanju građevinskih materijala



„Samo-čišćeći” betoni



Betoni „armirani” nanotubama

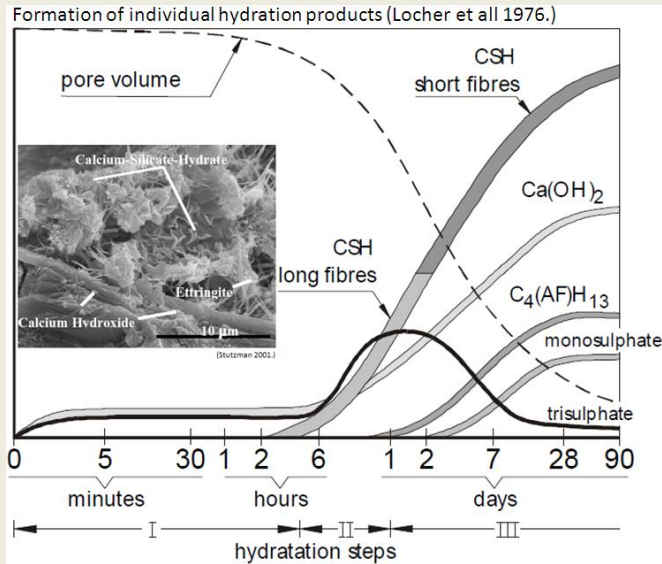


„Samoizlječivi” betoni



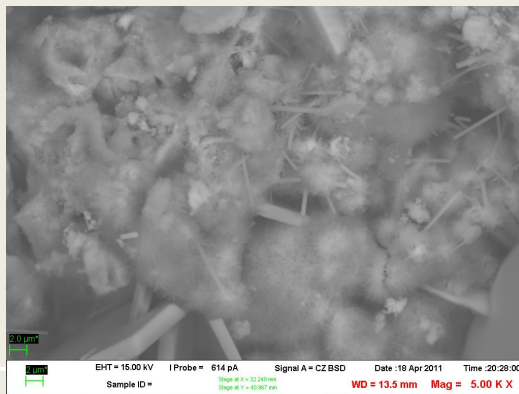
Prozirni / LED osvjetljeni betoni

Proučavanje procesa hidratacije

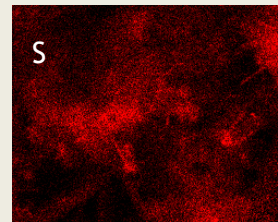
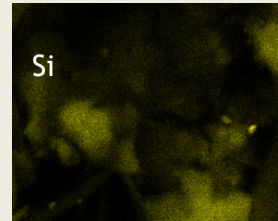
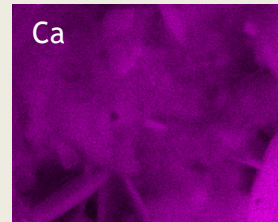


Proces hidratacije cementne čestice i vode

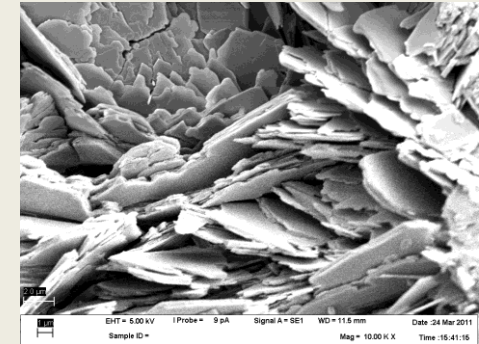
Emisijska spektroskopija, EDS



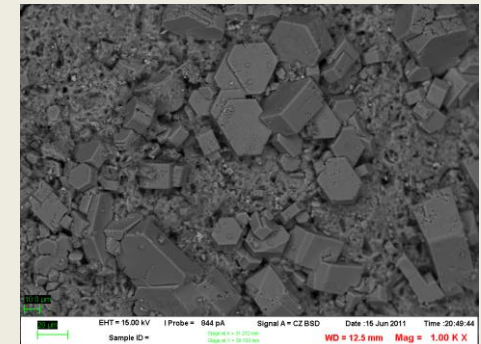
C-S-H gel



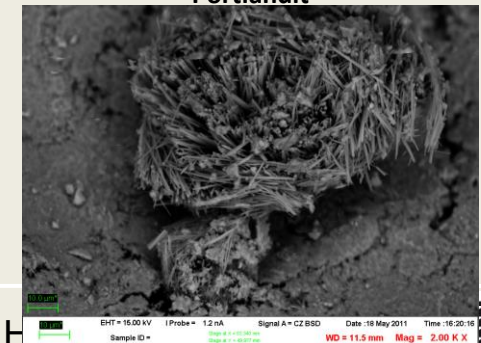
Pretražni elektronski mikroskop, SEM



Monosulfati

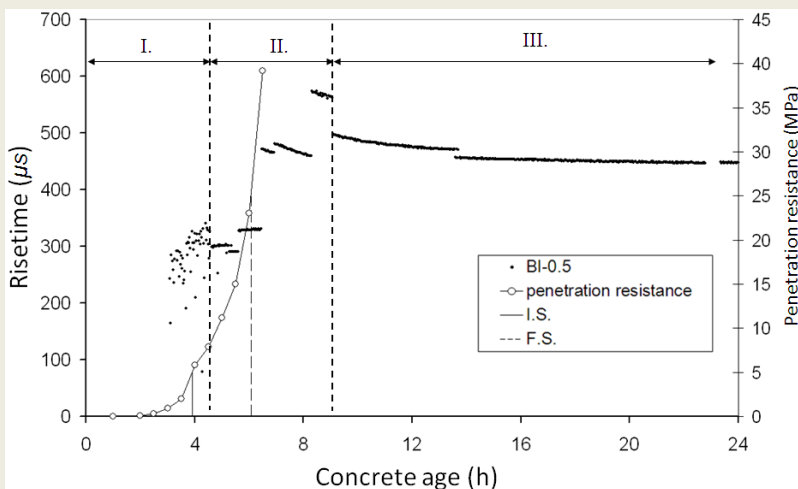


Portlandit

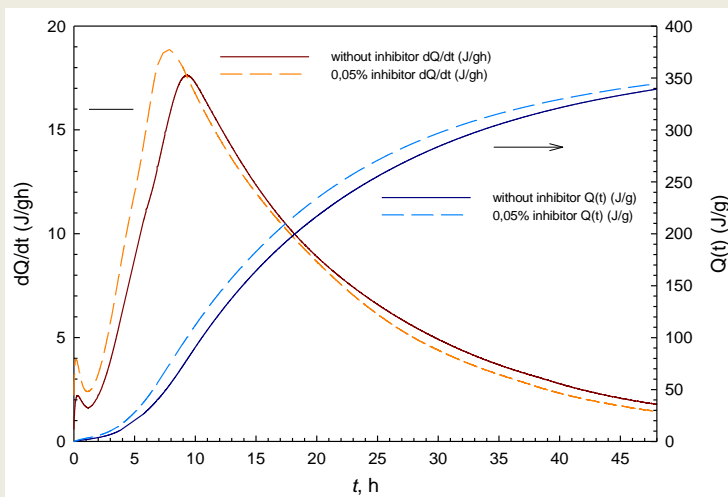


Ettringit

Proučavanje svojstava produkata hidratacije

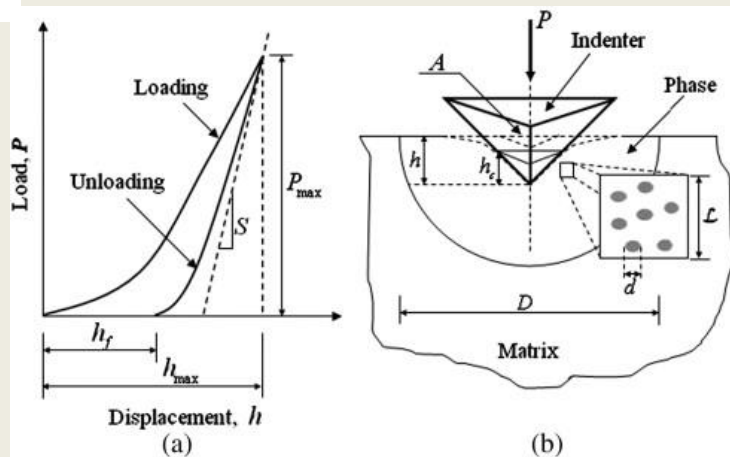


Promjena ultrazvučnih parametara tijekom hidratacije



Oslobodena toplina tijekom hidratacije

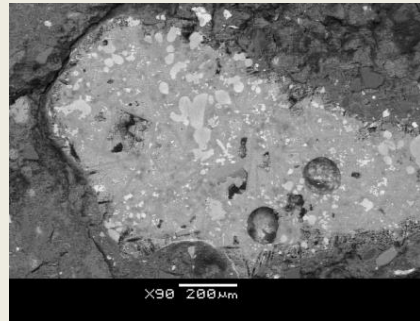
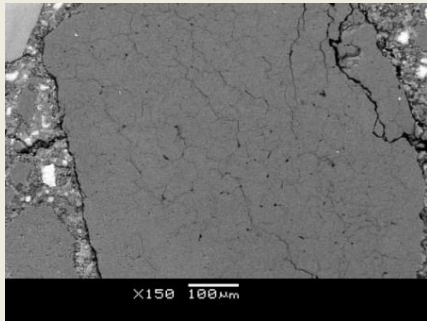
- Akustična emisija
- Nano-, mikro-indentacija
- Kalorimetrija
- DTA TGA



Određivanje mehaničkih karakteristika produkata hidratacije



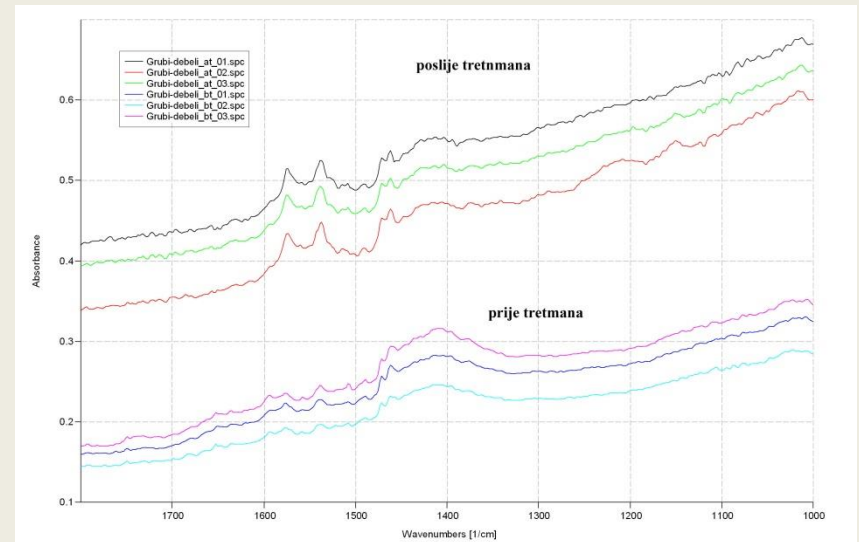
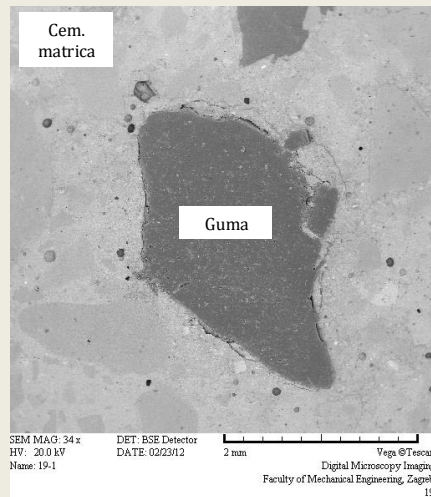
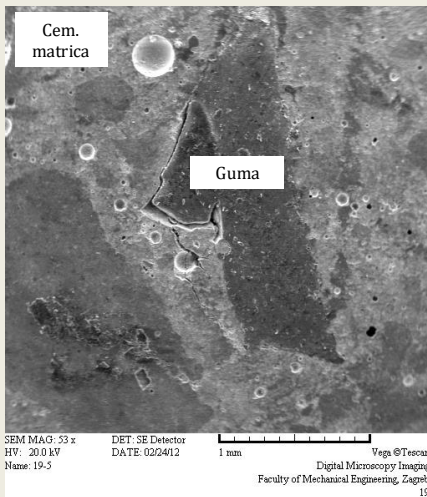
Proučavanje sučeljka cementne matrice i otpadnih materijala



Pretražni elektronski
mikroskop, SEM

Infracrvena spektroskopija,
ATR-IR

SEM snimke izgleda agregata nakon izlaganja temperaturi od 800 °C, a) dolomit i b) zgora



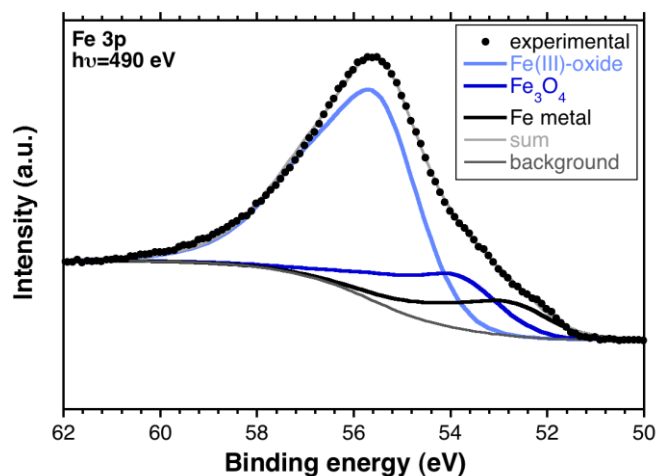
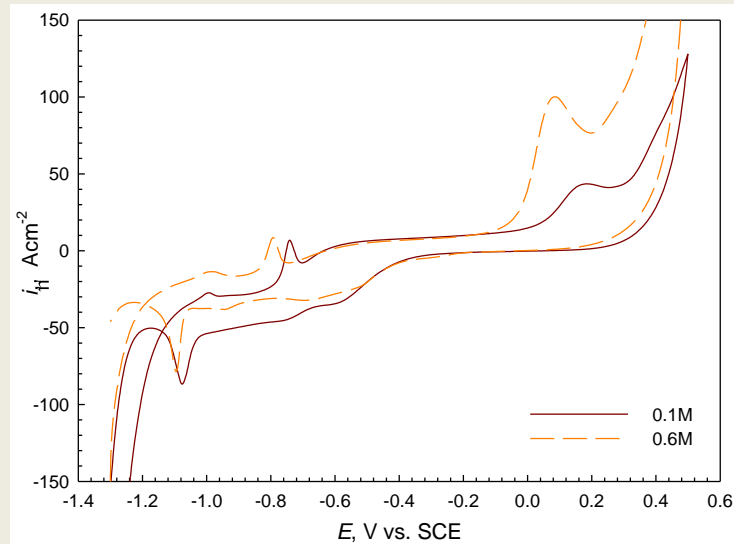
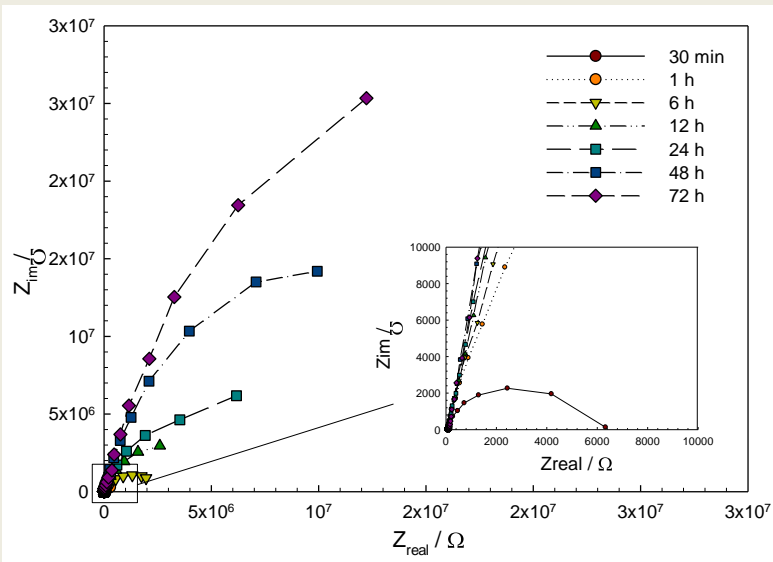
Utjecaj obrade gume na svojstva betona s dodatkom reciklirane gume



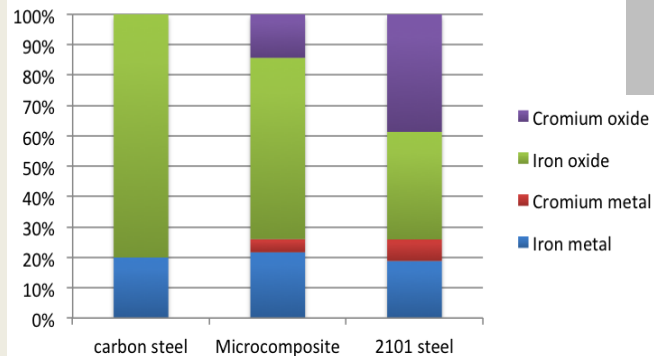
Proučavanje nanometarskih slojeva

Elektrokemijska impedancijska spektroskopija

Ciklička voltametrija



Oxide composition @ 500 eV

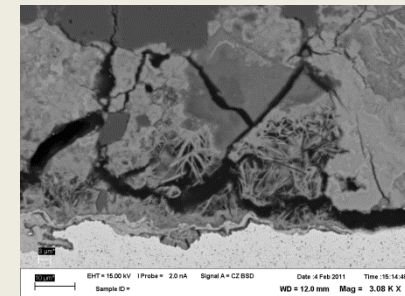
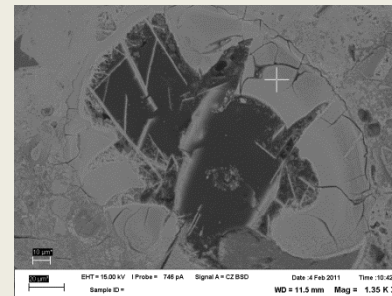
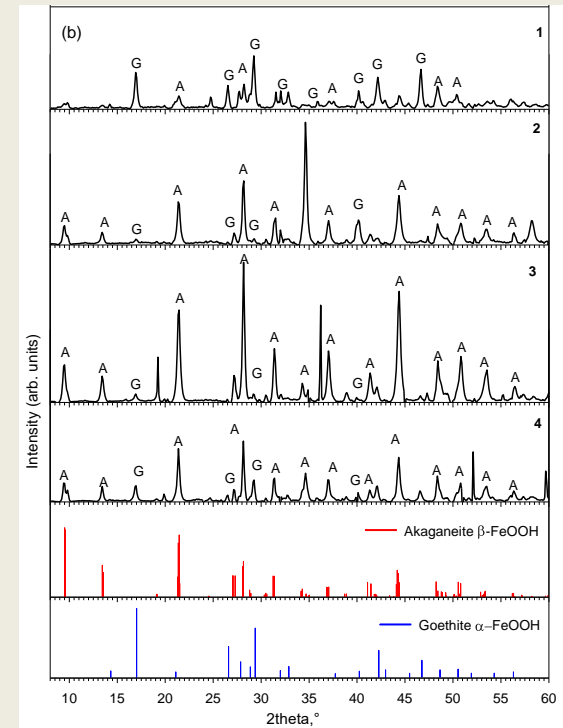
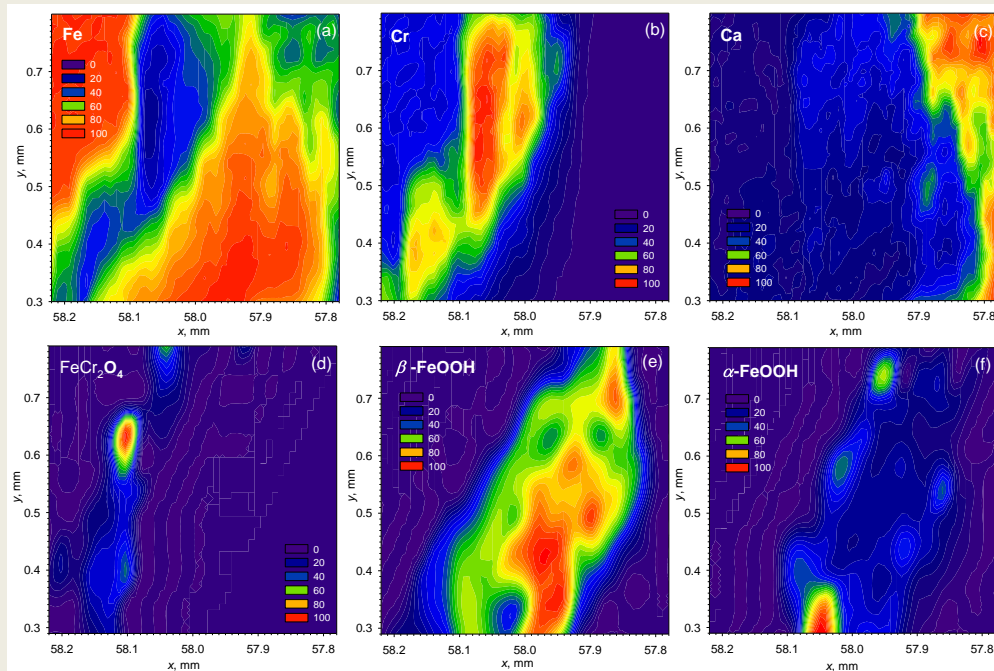


Rendgenska fotoelektronska spektroskopija XPS



Proučavanje nanometarskih kristalnih struktura

Rendgenska mikrodifrakcija i fluorescencija μ -XRD i XRF



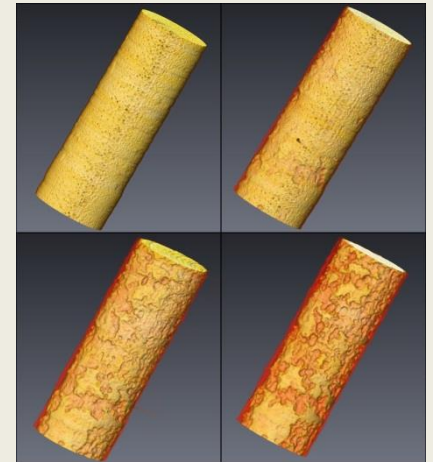
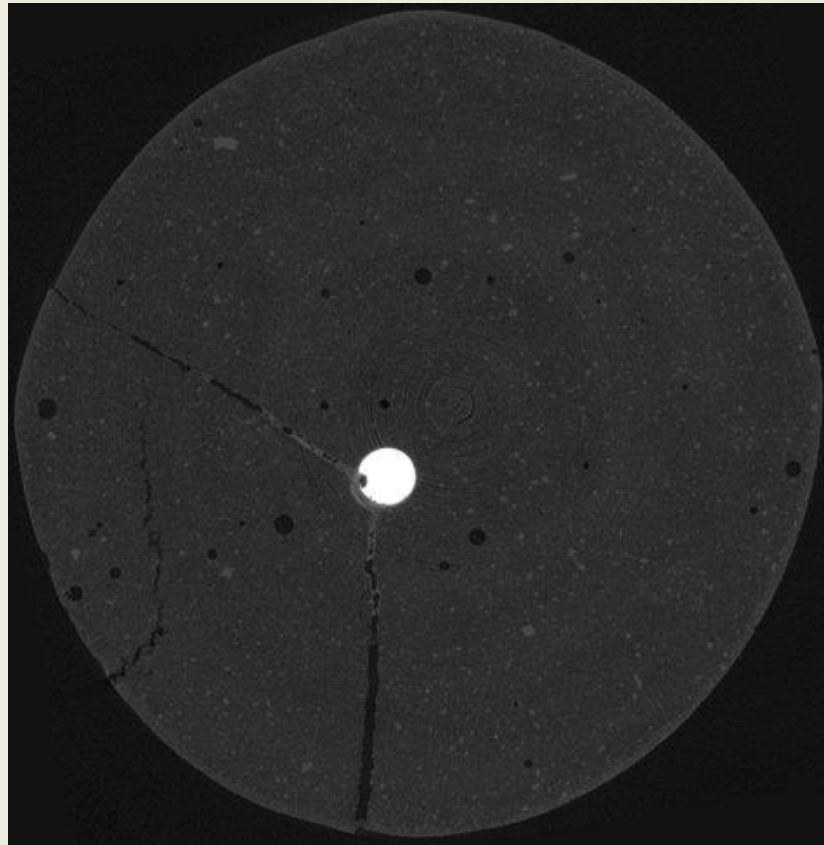
Serdar, Marijana; Meral, Cagla; Kunz, Martin; Bjegović, Dubravka; Wenk, Hans-Rudolf; Monteiro, Paulo J.M. Spatial distribution of crystalline corrosion products formed during corrosion of stainless steel in concrete. // Cement and concrete research. 71 (2015) ; 93-105



Proučavanje mehanizama degradacije

Galvanostatsko
ispitivanje

μ -tomografija
 μ -CT



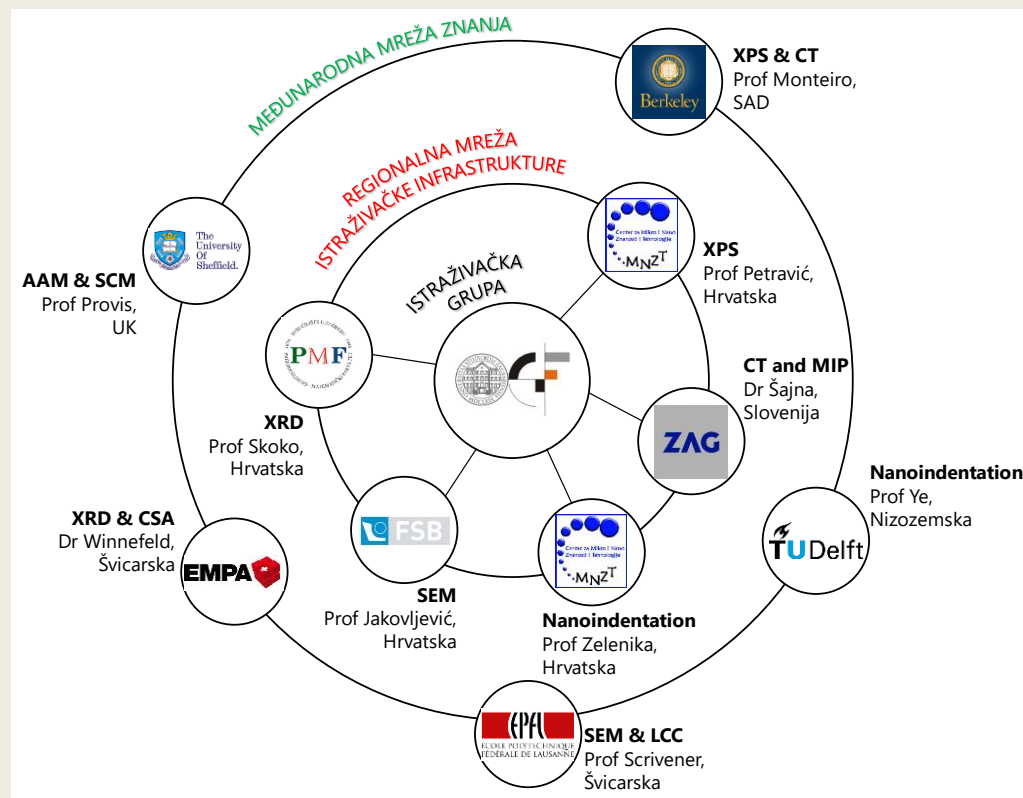
Itty, Pierre-Adrien; Serdar, Marijana; Meral, Cagla; Parkinson, Dula;
MacDowell, Alastair A; Bjegovic, Dubravka; Monteiro, Paulo J.M. In-situ 3D
monitoring of corrosion on carbon steel and ferritic stainless steel embedded
in cement paste. // Corrosion science. 83 (2014) ; 409-418



Uspostavni istraživački projekt

Alternativna veziva za beton: razumijevanje mikrostrukture za predviđanje trajnosti - ABC

- osnivanje centra izvrsnosti za istraživanja, razumijevanje i korelaciju mikrostrukture i trajnosti alternativnih veziva za beton
- osposobljavanje za samostalno korištenje naprednih analitičkih instrumentalnih metoda, koje osigurava regionalna mreža istraživačke infrastrukture
- obučavanje od strane međunarodnih centara izvrsnosti u istraživačkom području



Uspostavni istraživački projekt ABC

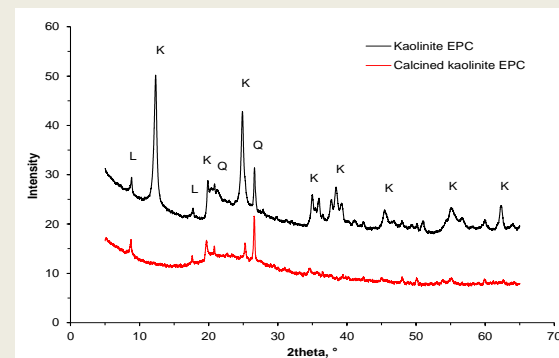
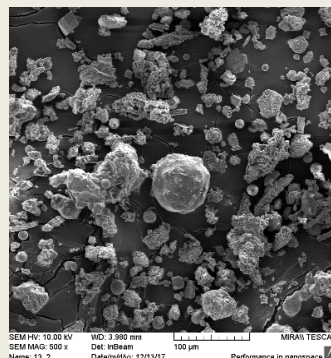
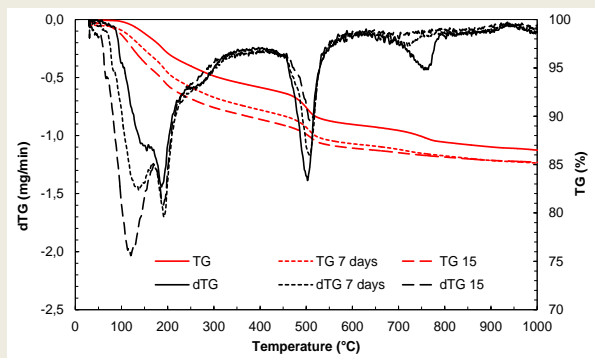
- Hipoteze na kojima se temelji ABC projekt su:
 1. u regiji postoje u dovoljnim količinama otpadni ili neiskorišteni nusproizvodi koji imaju potencijal za korištenje pri pripremi alternativnih veziva za beton,



Pronalaženjem mogućih primjena industrijskih otpadnih materijala moguće je izbjeći ekološke probleme (koji bi mogli dovesti do ekoloških katastrofa) i velike troškove odlaganja (koji bi mogli dovesti do povećanja troškova energije ili materijala).

Uspostavni istraživački projekt ABC

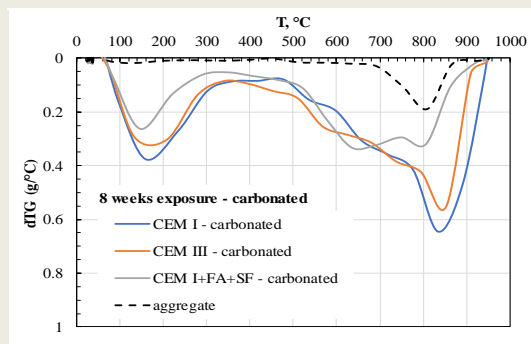
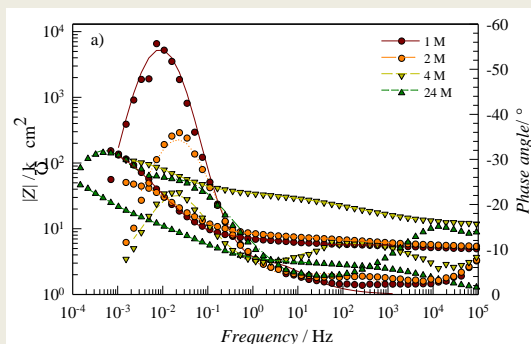
- Hipoteze na kojima se temelji ABC projekt su:
 2. uz pomoć analitičkih metoda i fundamentalnijeg pristupa istraživanju moguće je potpuno iskoristiti potencijal takvih materijala i pretvoriti ih iz otpada u vrijedne sirovine za razvoj alternativnih veziva



Vrlo je važno koristiti temeljnije pristupe istraživanju alternativnih veziva, kako bi mogli potpuno razumjeti njihova svojstva od nano do makro razine i postići veliku ili ukupnu zamjenu cementa.

Uspostavni istraživački projekt ABC

- Hipoteze na kojima se temelji ABC projekt su:
 3. moguće je povezati promjene alternativnih veziva na mikrostrukturnoj razini s promjenama svojstava na makro-razini, sve kako bi se predvidio uporabni vijek alternativnih veziva u agresivnom okruženju

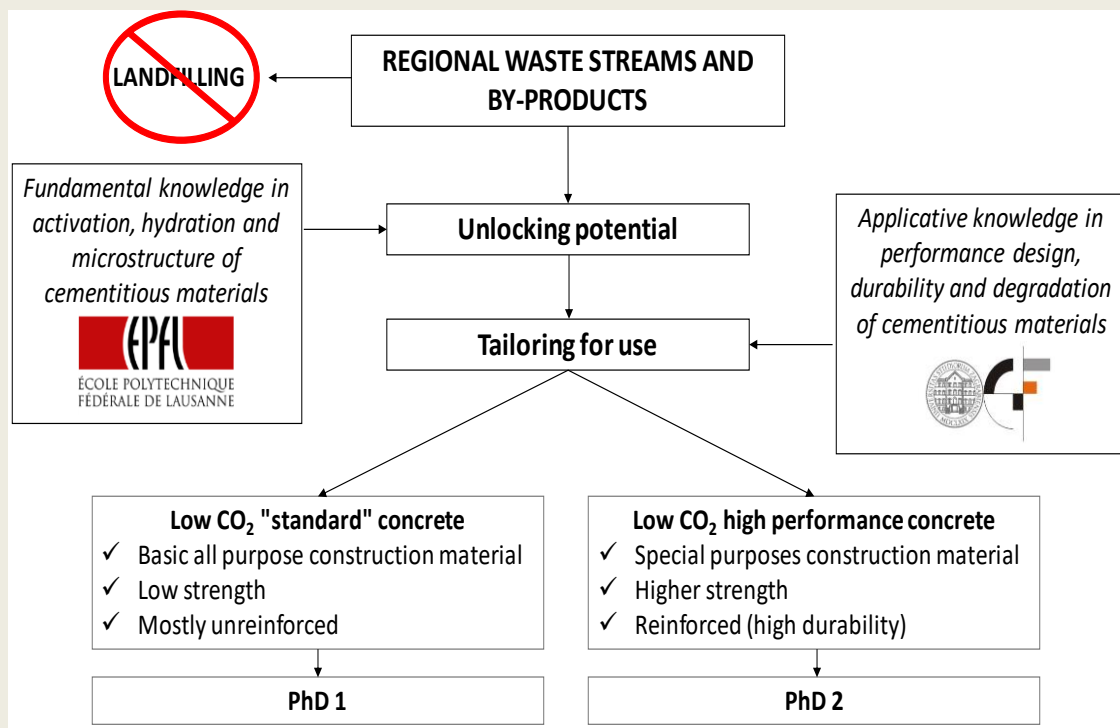


Napredne analitičke metode i pouzdani modeli uporabnog vijeka mogu pružiti uvid u dugoročnu trajnost alternativnih veziva, sve u svrhu predviđanja njihovog uporabnog vijeka u agresivnom okolišu.

Suradnja Švicarska – Hrvatska

ADVANCED LOW CO₂ CEMENTITIOUS MATERIALS ACT

- Cilj projekta: razvoj održivih i trajnih betona baziranih na dostupnim regionalnim otpadnim i nekorištenim materijalima



Suradnja Švicarska – Hrvatska

ADVANCED LOW CO₂ CEMENTITIOUS MATERIALS ACT

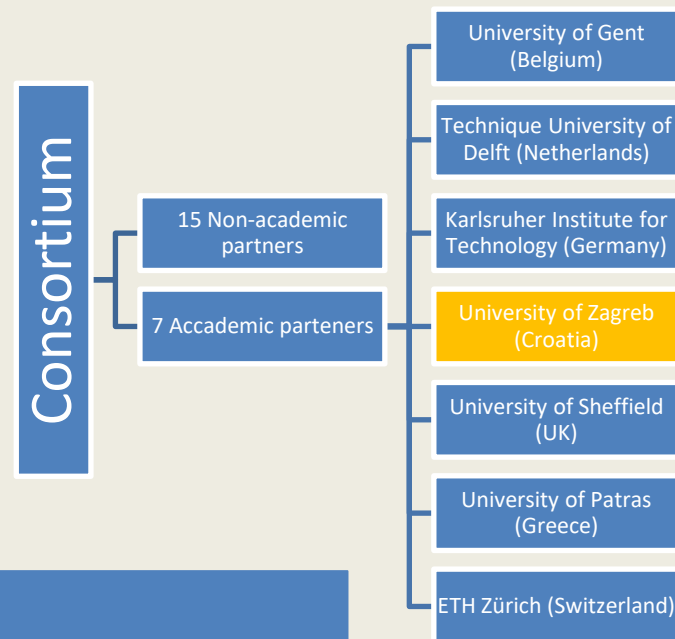
- Faza 1: Nabava regionalnih materijala i karakterizacija
- Faza 2: Projektiranje mješavina s niskim udjelom CO₂ na bazi regionalnih materijala:
 - A) „običan” betona (uobičajena primjena)
 - B) beton velikih uporabnih svojstava (posebne primjene)
- Faza 3: Evaluacija rezultata
- Faza 4: Priprema disertacija



Međunarodna suradnja

International Training Network on Alkali-Activated Materials DuRSAAM

- Collaborative international and multidisciplinary training founded by MARIE SKŁODOWSKA-CURIE ACTIONS Innovative Training Network of EU HORIZON 2020 Programme.
- International network of 13 Ph.D. students in 7 different European University.



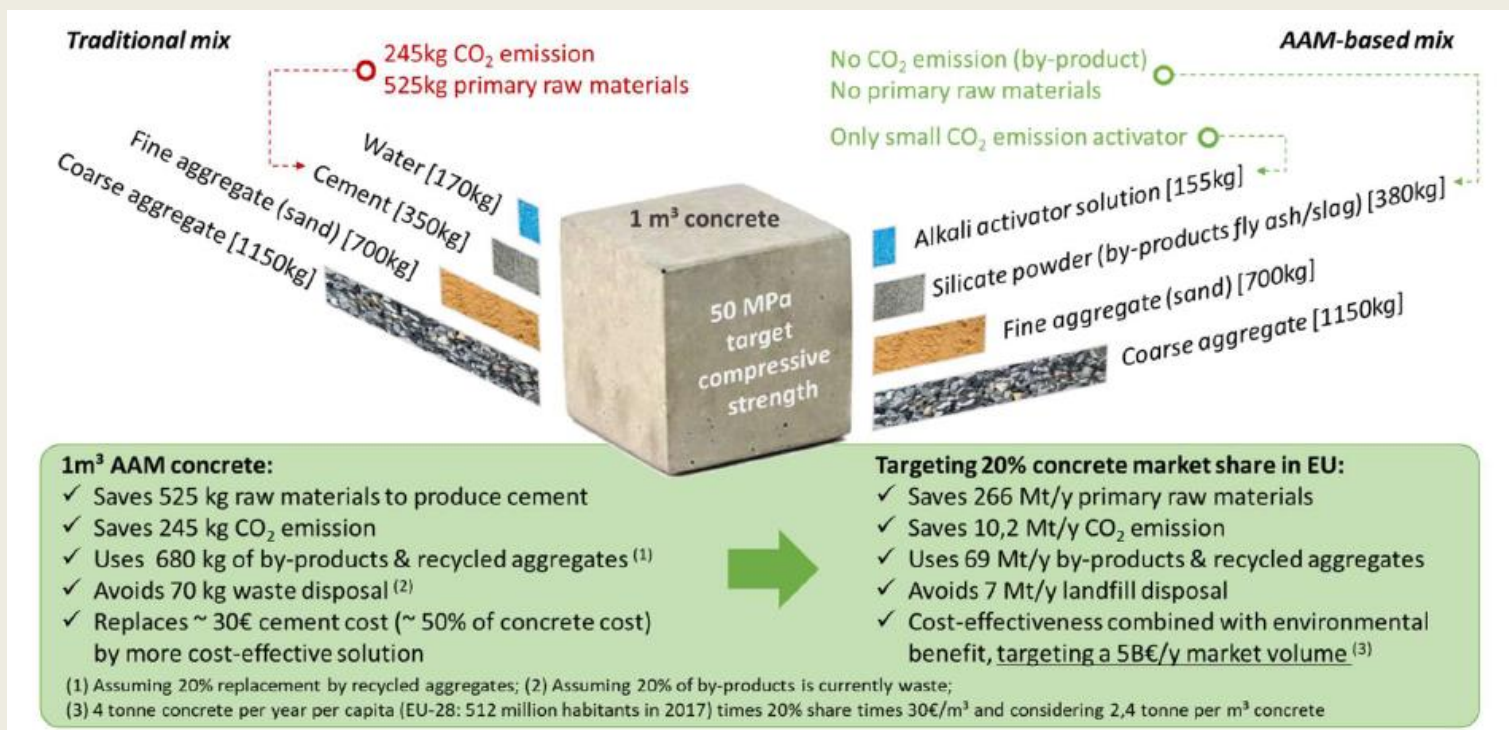
The Mission of DuRSAAM

To strengthen the European research area on eco-efficient construction materials and the increased competitiveness of Europe's construction sector, in applying concrete technology based on alkali-activated materials (AAM) for a more sustainable build environment.



Međunarodna suradnja

International Training Network on Alkali-Activated Materials DuRSAAM



Međunarodna suradnja

International Training Network on Alkali-Activated Materials DuRSAAM

Chloride ingress and corrosion of steel in AAM concrete

AIM: development of understanding of **chloride ingress** and resulting chloride-induced **corrosion of steel** in AAMs and propose methodology of their mitigation.

- Prof. J. Provis (University of Sheffield)
- Prof. F. Dehn (Karlsruher Institute for Technology)

Combined environmental actions

AIM: **simulation of the degradation process** in AAMs under combined effect of at least two environmental or mechanical actions. The simulations and experiments will consider the effect of shrinkage, freeze-thaw, carbonation and chloride transport separately and in a coupled manner, together with mechanical loading.

Prof. Guang Ye (Technique University of Delft)



Zaključak

- Ulaganje u znanost, istraživačka infrastruktura i inovacije međusobno su povezani
- Jedino sustavnim ulaganjem u znanost i strateškim razvojem istraživačke infrastrukture može se provoditi izvrsna znanost



Hvala na pažnji!

Marijana Serdar
mserdar@grad.hr

