Dealing with post-irradiation examination residues in Brazil

ipen
nuclear and energy research institute

IAEA

1 Introduction to IPEN

ipen

Nuclear and Energy Research Institute

Part of the National Nuclear Energy Commission of Brazil (CNEN)

Located in University of São Paulo

Since 1956

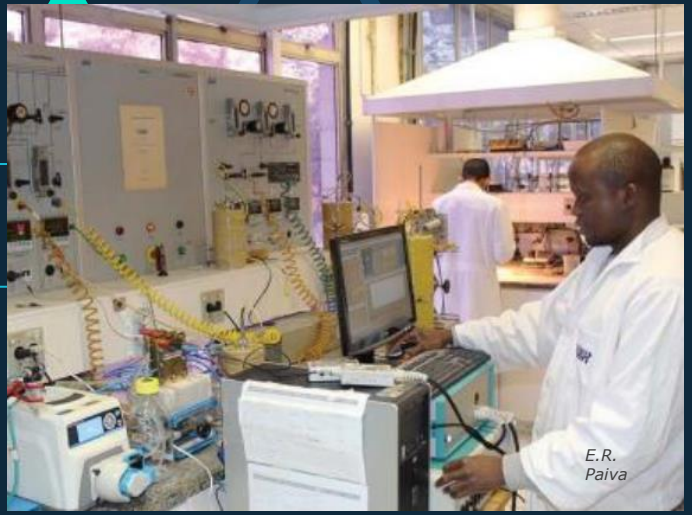
Around 500 professionals and 600 students

Production, research and education

- Radioisotopes and other services and products
- IC, Msc, Msc professional, PhD, postdoc
  - Nuclear Technology and Health Sciences

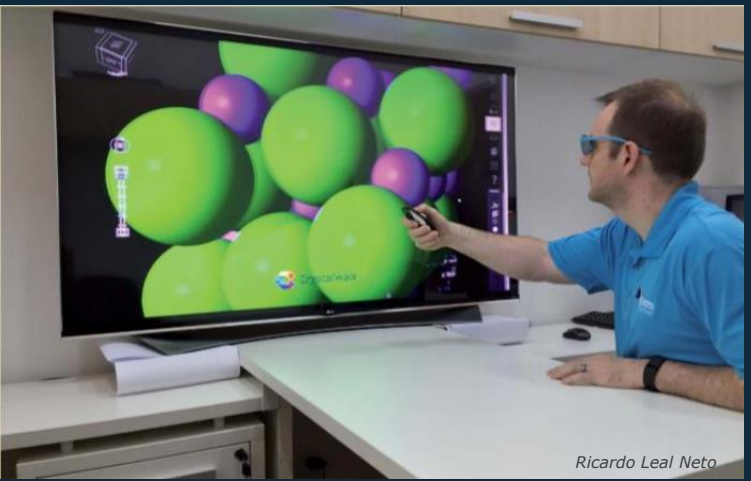

IPEN progress report 2008-2010


PORT 2.2

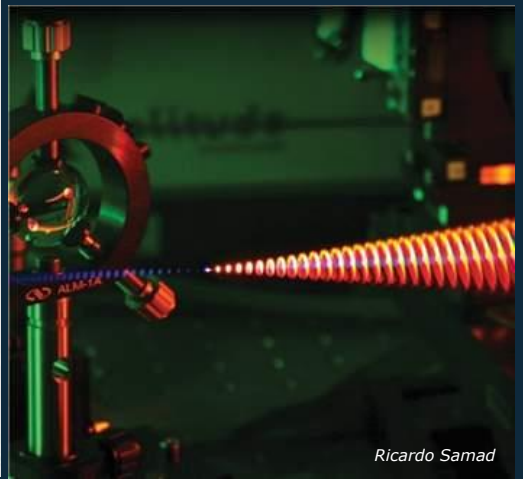

E.R. Paiva


Marcello Vitorino


IPEN progress report 2008-2010

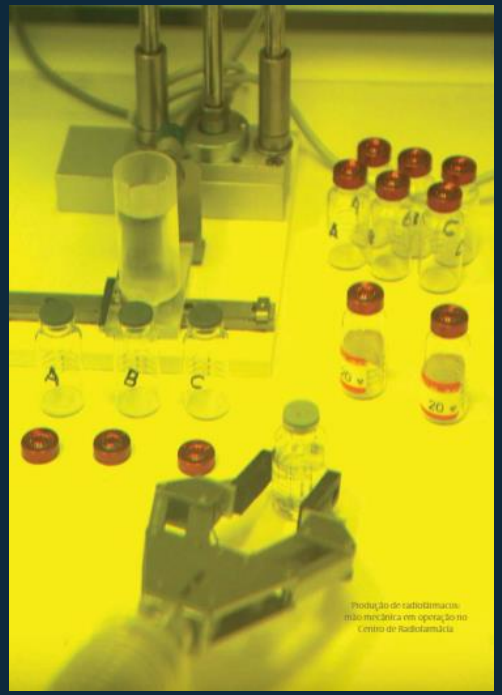

Ricardo Leal Neto

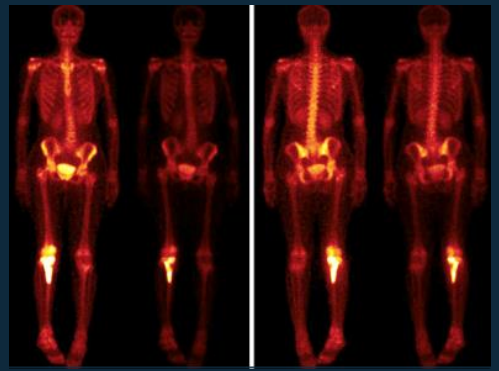

Ricardo Samad


Ricardo Samad

Radiopharmaceuticals

- 26 products
- Main: Tc - 99m
- 2mi procedures / year
- Hospitals and clinics around Brazil





CECON

Nuclear Fuel Center

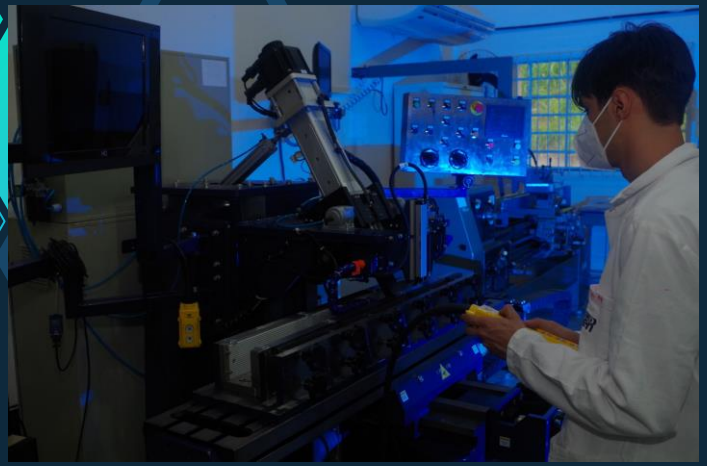
Production + Research

- Nuclear fuel elements for research reactors in Brazil.
  - IPEN, IEN, CDTN, **RMB**
- (Uranium targets)

- New fuels and uranium targets
- Materials characterization labs
- Partnership with universities and research institutes
- Grad, MSc, PhD and postdoc

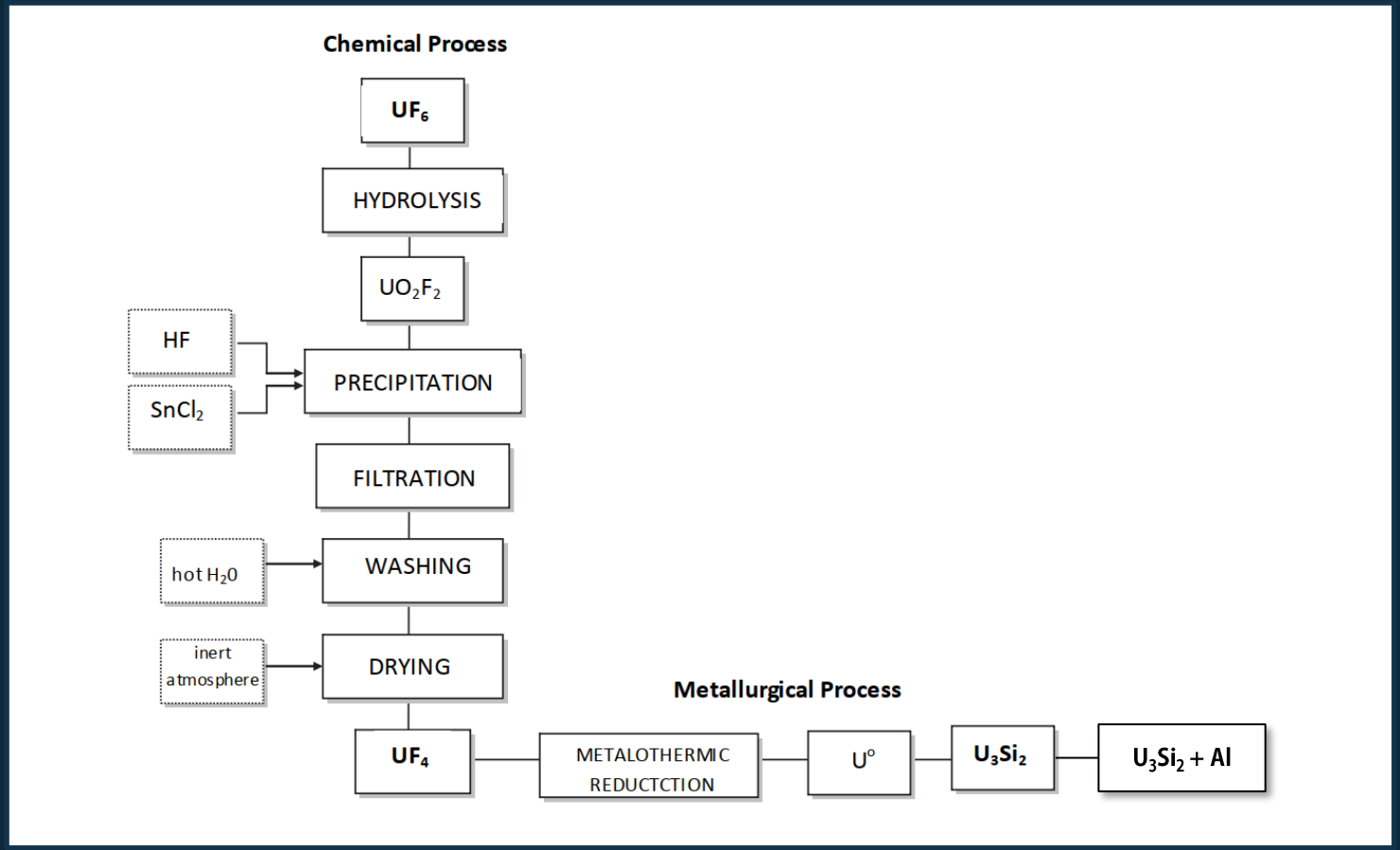
Nuclear Fuel Center

E.R. Paiva




Marcello Vitorino

NFE Production process



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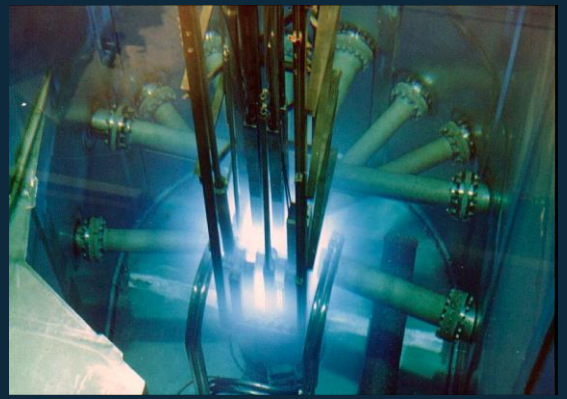
Nuclear Fuel history at IEA-R1

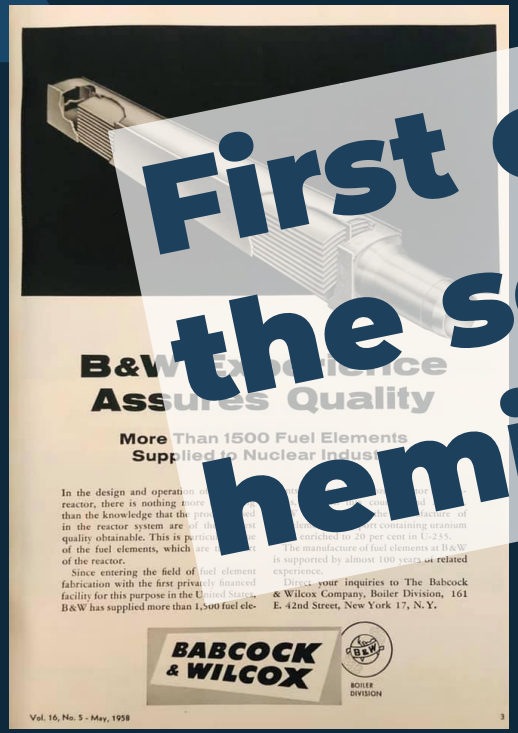


A.C. Iglesias Rodrigues

IEA-R1

- MTR
- 4.5 MW
- LEU fuel elements composed of 18 plates (~ 10g of 235U each plate)
- 5x5 configuration

NFE's history at IEA-R1



First criticality in the southern hemisphere

- [illegible] configuration was 5x6 (fuel elements from Babcock & Wilcox);
- [illegible] U-Al, 1,9 gU.cm^{-3} , 19.75%
- 40 NFE's
- [illegible] ted pit of corrosion
- 1961, 39 NFE's substituted the first ones
- 1968, 43 NFE's from UNC/USA and NUKEM (Germany);
  - Flat plate, U-Al alloy, 0.6 gU.cm$^{-3,}$ 93%;

NFE's history at IEA-R1

- 80's - conversion from HEU to LEU was started;
- 1981 - 5 fuel elements U-Alx alloy with 19.75% (NUKEM);
- 1985 IPEN started to produce its own fuel elements;
  - 2 prototypes (U_3O_8-Al, 1.9 $gU.cm^{-3}$ – 19.75 %) examined in the IEA-R1;

NFE's history at IEA-R1

- 1988 first Brazilian fuel elements were placed in the core (LEU);
- 18 fuel elements production (U density was increased to 2.3 $gU.cm^{-3}$);
- 1998 started using U_3Si_2 ,LEU, with 3.0 $gU.cm^{-3}$;
- Burnup: 50 U at%.

NFE's history at IEA-R1

- Two irradiated fuel transfers to USA:
  - 1999 (127 spent NFE's)
  - 2007 (33 spent NFE's)

C

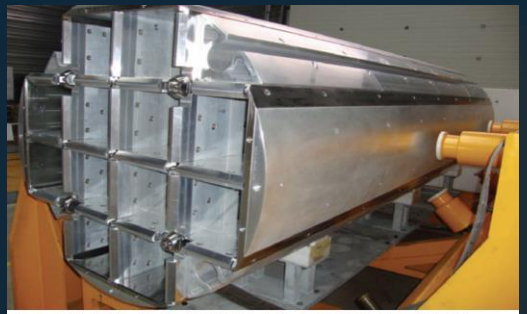
Current situation

Current situation

- 24 NFE's in reactor (20 std, 4 control)
- 3.0 gU/cm^3 of U_3Si_2 in aluminium matrix
  - 4.8 gU/cm^3 was fabricated but not qualified yet
  - 19 NFE's 3.5g/cm^3 of U_3Si_2 in aluminium matrix were fabricated for the new RMB reactor

Current situation

- 57 spent NFE's stored in stainless steel/aluminium coated basket inside the reactor's pool
- 32 other positions occupied with other irradiated devices
- 19 free spots
- (total 108 positions)
- At 4.5MW and 32/h week, it should last 6 years
- Future perspective: boralcan™ basket



TN 117 BASKET, DESIGNED BY TN INTERNATIONAL

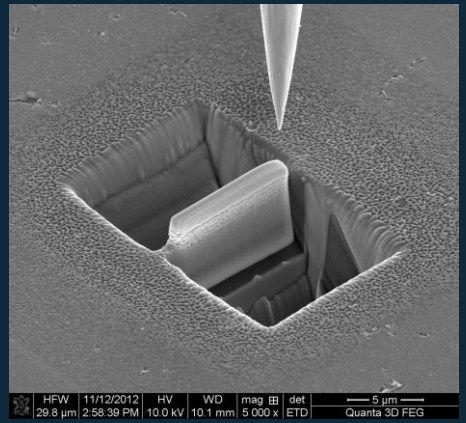
M

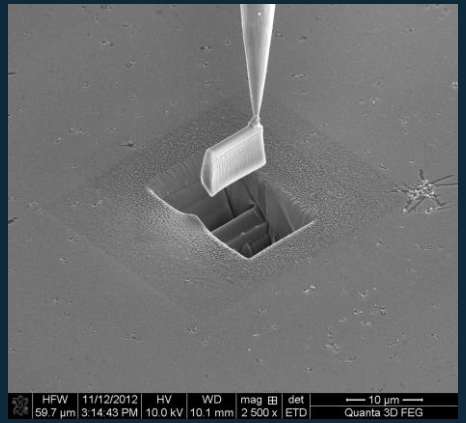
Microsampling

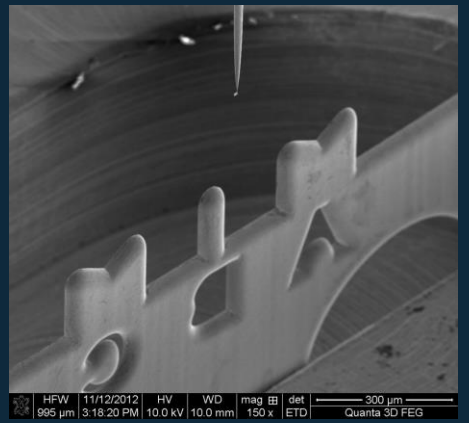
Microsampling

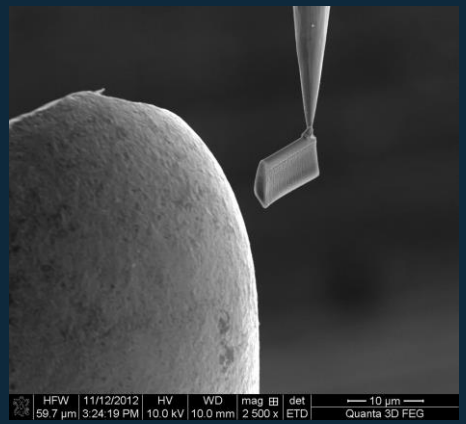
- Why?
  - Less sample used
  - Less residue generated
  - Exponential reduction of dose
    - Samples can be transported without special shielding

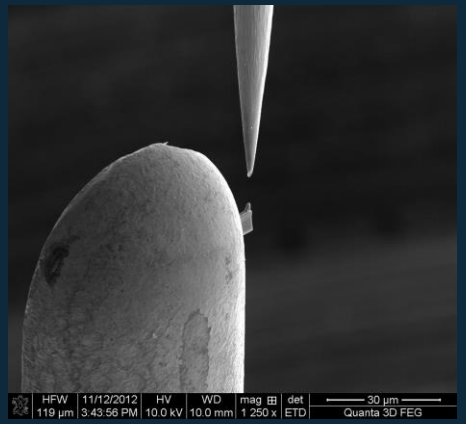
Microsampling with FIB

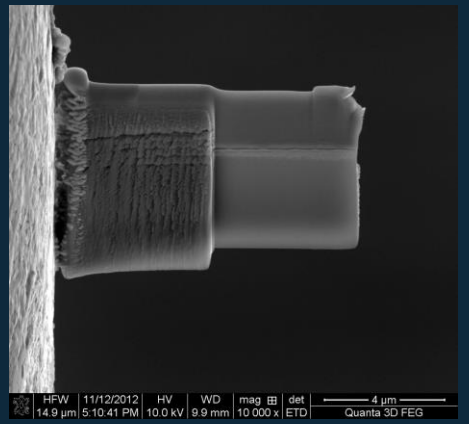








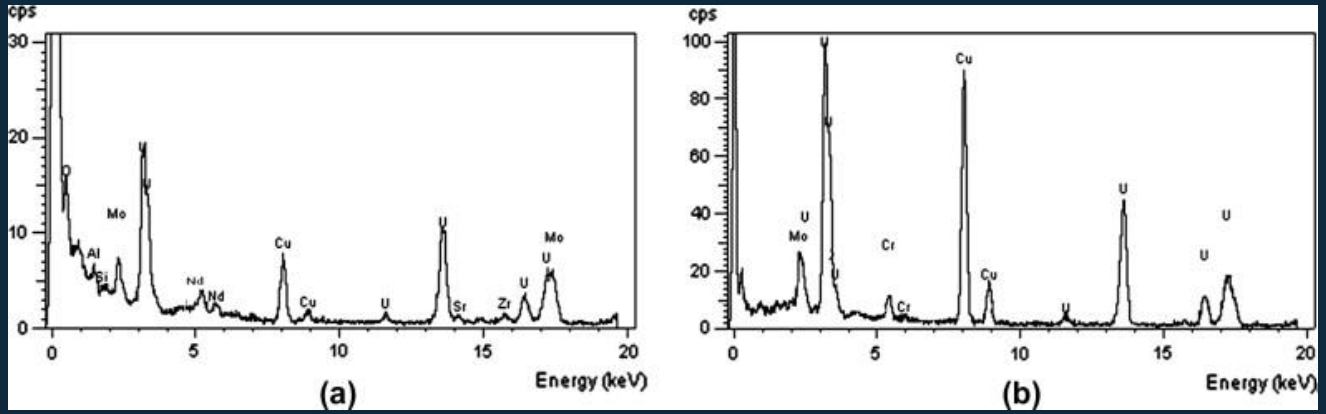




Emanuele Enrico

Microsampling with FIB

- EDS of irradiated UMo macro sample / micro sample



Brandon Miller / INL

Microsampling examples

- **TEM** (10x10x2µm) thickness adjustment
- **SEM** (100x100x5µm) near perfect surface and better EDS signal
- **APT** (10x10x10µm) conic shape
- **Analytical Lab** (15x15x15µm) virtually free of contamination
- **Nanoindenter** (300x300x300µm)
- **PPMS** (15x5x5µm)
- **SLICE TOMOGRAPHY** (150x150x150µm)
- **SIMS** (40x40x40µm)

Thank you!

Questions?

teo@usp.br