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ON-GOING EP ACTIVITIES AT CEA SACLAY

Fabien Éozénou

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OUTLINE

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- CONTINUOUS OPERATION OF EP SET-UP
- RESULTS WITH STANDARD 1-9 MIXTURE
- CHANGE IN PARAMETERS
- LAST SAMPLES RESULTS (AGING OF THE BATH)

- COMSOL MODELING (Presentation by M. BRUCHON)

SINGLE CELL ELECTROPOLISHING

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Material

- PFA pipes
- PVCC Tank + internal cooling PVDF pipe
- Nitrogen Flow in cavity and tank
- Data Monitoring : I, T, V
- Some pneumatic valves

First operation with acid: 10-17-2006

First cavity (1DE1) polished for test: 10-24-2006

- Processing @ constant voltage: 17 Volt
- 1 Vol HF (40%) - 9 Vol H_2SO_4 (95%) Mixture (Fresh bath)
- Ethanol rinsing

CONTINUOUS EP PROCESSING

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- The set-up is running well. 14 treatments have been carried out.
- We have improved our procedures → Continuous operation of the process.
- Data monitoring and process driving systems: OK.
- 2 bathes investigated: 1 vol HF – 9 vol H_2SO_4 (5 Volt and 17 Volt) and 1 vol HF – 2 vol H_2SO_4 – 7 vol H_2O (8 Volt)

  Work is in progress within 5.1 (CARE SRF).

- 2 DESY Cavities have been prepared (RF tests at DESY):
  - -1DE1 (tested).
  - -1DE3 (waiting for test).

- RF Tests at Saclay will start at the end of April:
  - - 1C21 waiting for test.

EXAMPLE OF DATA MONITORING

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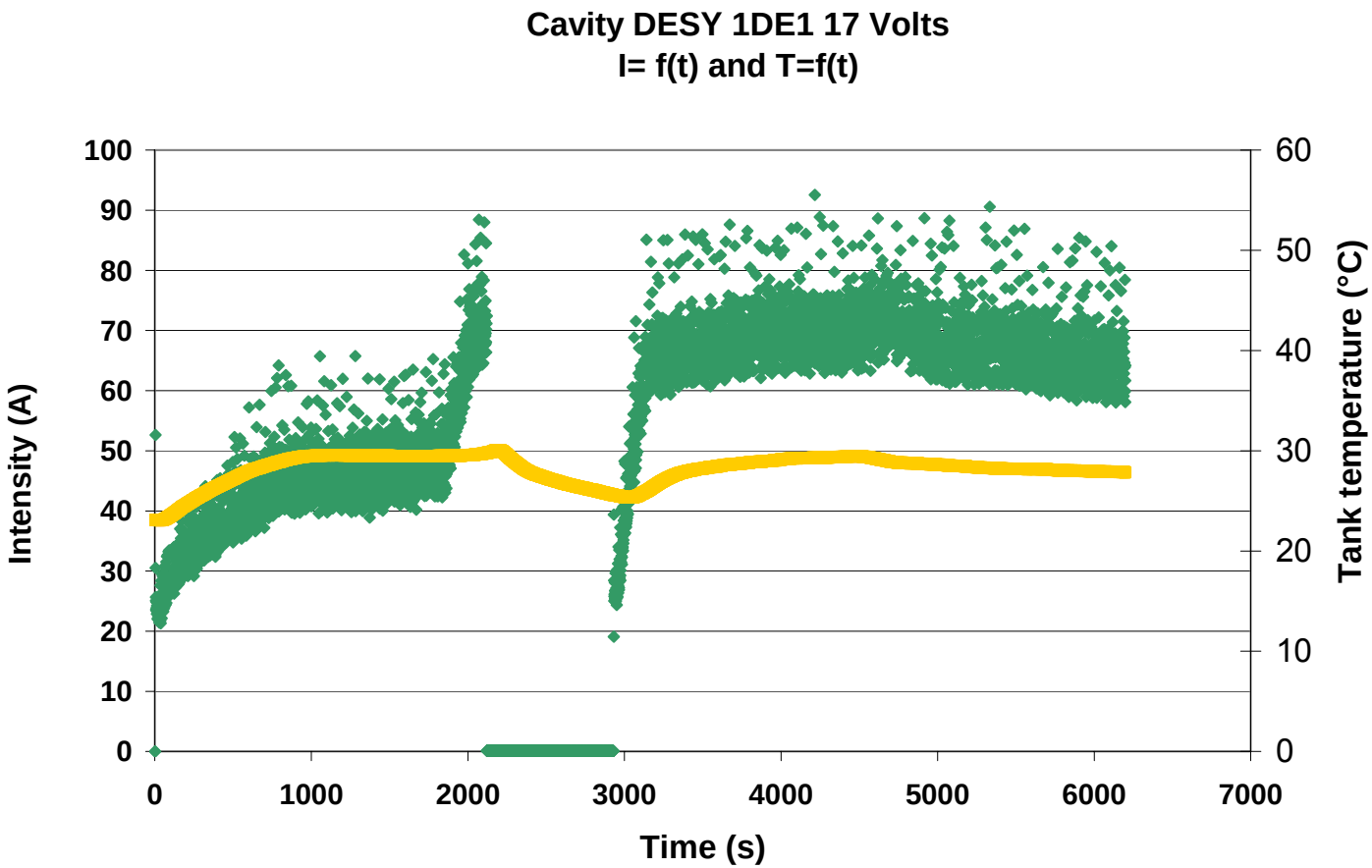

ACID GAS EXHAUSTS NEUTRALIZATION

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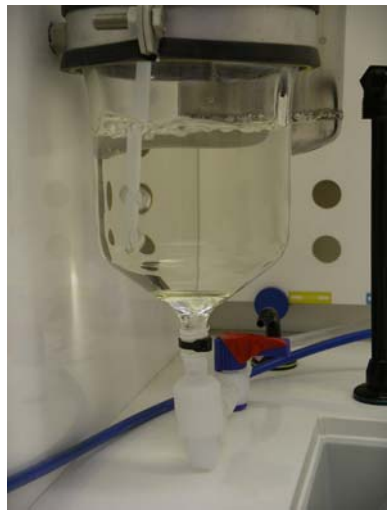
Acid gaseous exhausts of whole lab neutralized by a scrubber.

+ additional scrubber for EP Set-Up:

Sodium hydroxide

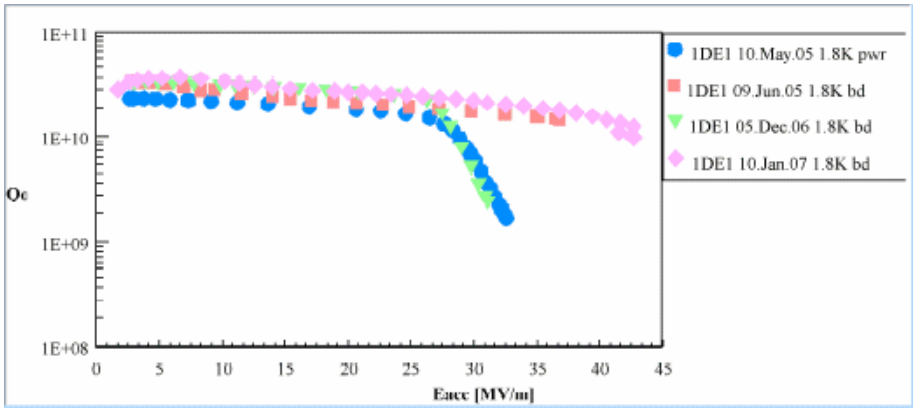
+ BTB $C_{27}H_{28}Br_2O_5S$



When the mixture becomes acidic, it turns yellow.

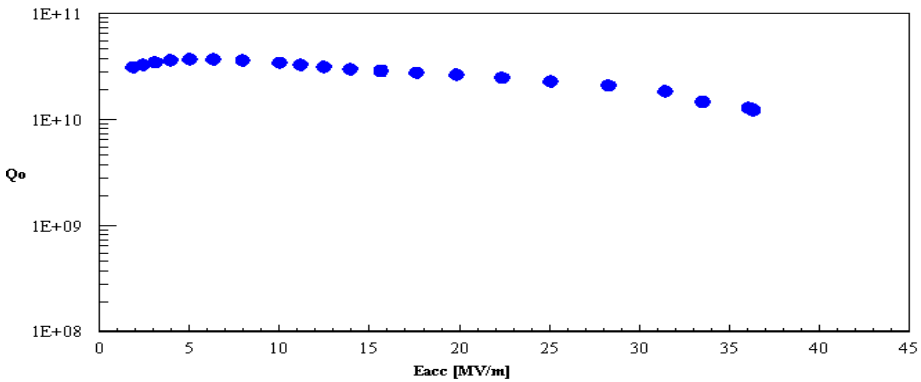
→ Way to evaluate degassed acid. Ex: > 0.1 mole in 45' when acid temperature is high.

FIRST RESULTS WITH 1DE1 CAVITY



- 42 µm removed
- Acid temperature: 25-30°C
- Voltage: ~17 Volt
- Maximum intensity: ~ 80 A
- Strong sulfur odor after treatment
- Ethanol rinsing
- Surface more shiny after treatment

42.7 MV/m @1.8K after baking +7MV/m / last treatment



- ~ 30 µm removed
- Voltage:~17 Volt
- Cooling system failure → T>43°C
- Strong degassing
- No current oscillation
- Loss of the shiny surface (in accordance with results on samples)

36.3 MV/m @1.8K after baking

Worse performance due to bad working conditions? → 1DE1 need to be treated again at Saclay.

OUTLOOK CONCERNING TESTS

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Comparison between Henkel (Working @ constant current) and Saclay results with:

- **1DE1 treated at Saclay again.**
- **1DE3 has been treated at Saclay (waiting for test at DESY).**

RF Test Infrastructure working again in May at Saclay:

- **Treatments and tests of a batch of TTF cavities from Saclay (CERCA & ACCEL).**
- **Reproduce Tests (S0 R&D Program). Possibility to use a different rinsing procedure.**

SEARCH FOR BEST EP PARAMETERS (WP 5.1 CARE SRF)

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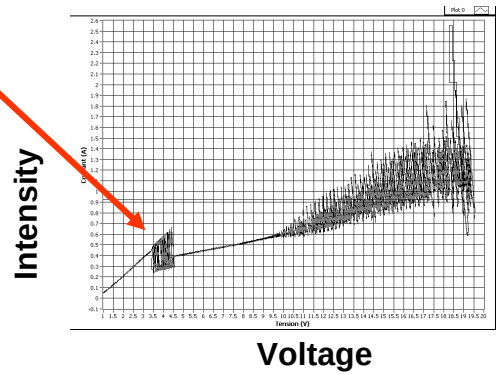
Voltage

- New Voltage has been investigated. 5 Volt with standard mixture

  Oscillation region → very shiny surface.

  (Cavity 1C21 waiting for test).



Concerning the study for different HF-H_2SO_4-H_2O mixtures

- Standard mixture works well.
- Water addition (Ex 1-9-1 mixture) undesirable

  (lower removal rate and deteriorated surface).
- High HF concentrations promising on samples → 3 - 6.72 - 0.28 mixture to be tested on single cell (low T, low voltage).
- What about diluted mixtures???

EP WITH 1-2-7 MIXTURE ON SINGLE CELL

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Cavities were treated at ~ 8 Volts (plateau region).

Advantages:

- **Easy to prepare the mixture.**
- **High removal rates achieved.**
- **High equator removal rate (to be confirmed). Might be due to prevailing diffusion phenomenon (higher speed at equator).**

But…

- **Surface after EP strongly depends on initial surface.**
- **Sulfur deposition on pipes.**
- **H content measurements on samples (by X. Singer at DESY) show concentration leading to Q disease.**

EP WITH 1-2-7 MIXTURE

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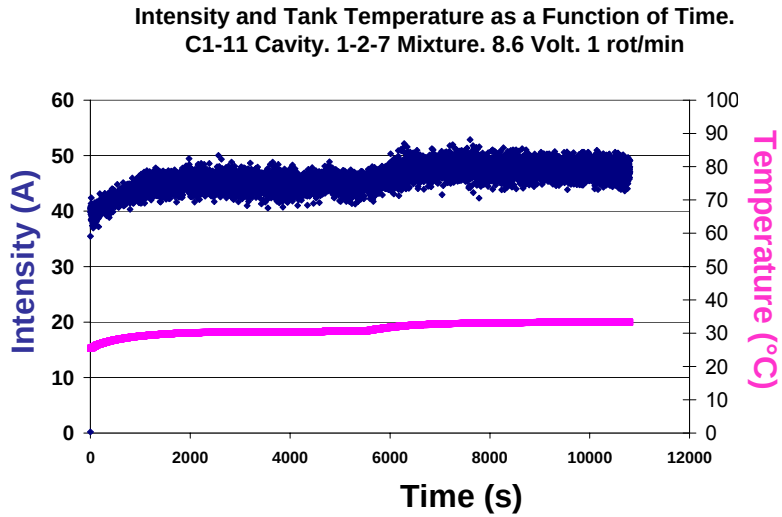
Intensity and temperature during treatment



Surface after 80 µm removal with 1-2-7 Mixture

Sulfur deposition on tubes after EP

Still an interest as a recipe for heavy (and fast) material removal ?

TESTS ON SAMPLES: ORIGINS OF AGING

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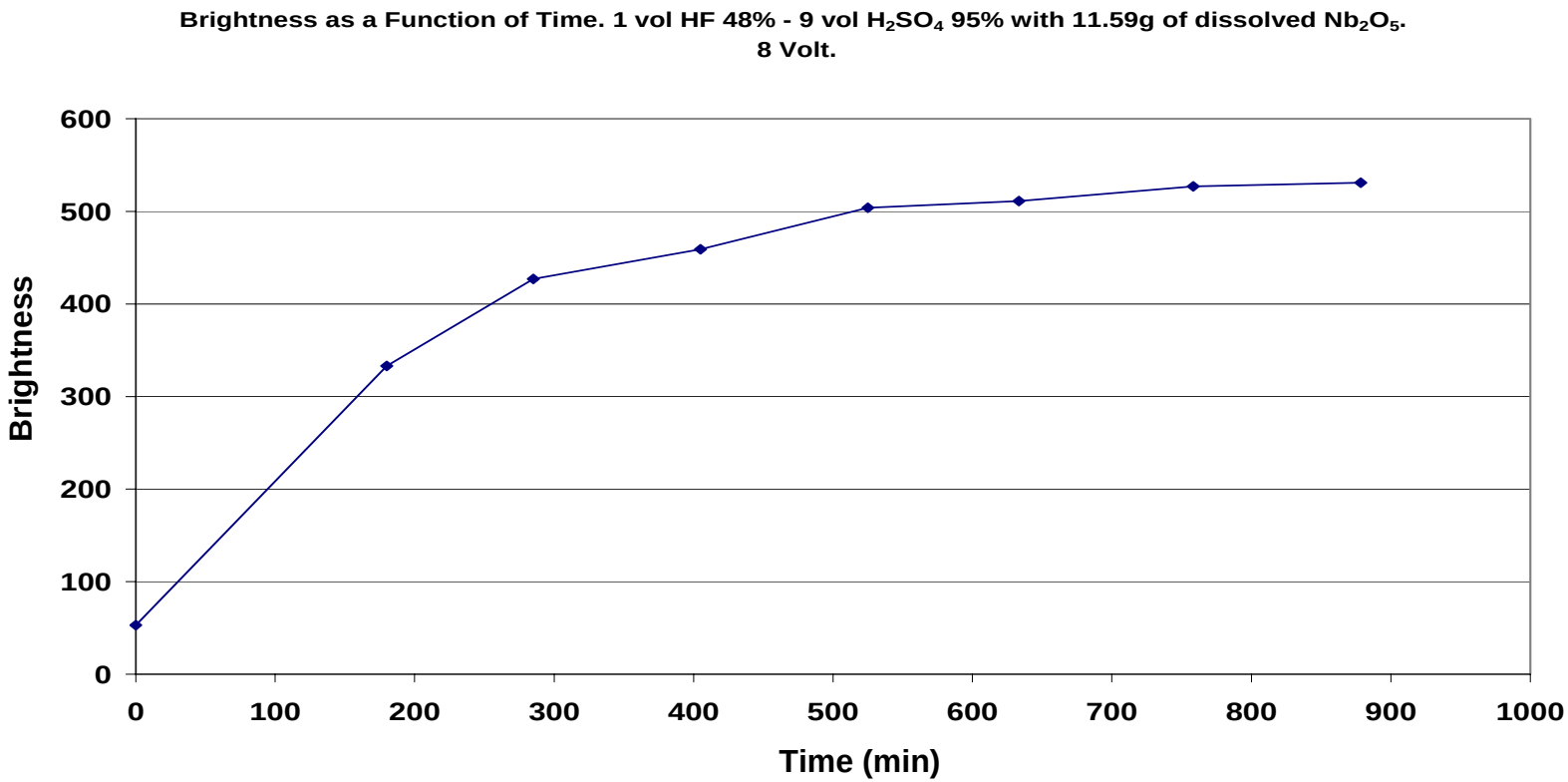
HF concentration: most relevant factor(?) Huge difference for the same quantity of niobium for different HF concentrations.

- **9 g/L in EP mixture prepared with $HF_{48\%}$: polishing effect.**



- **9g/L with $HF_{40\%}$ No polishing effect…(low brightness achieved).**

MODELING: see presentation by M. Bruchon

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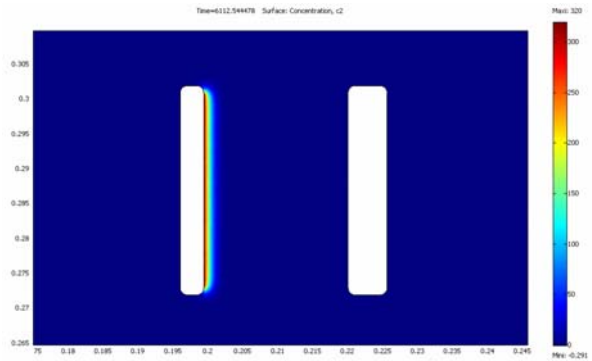
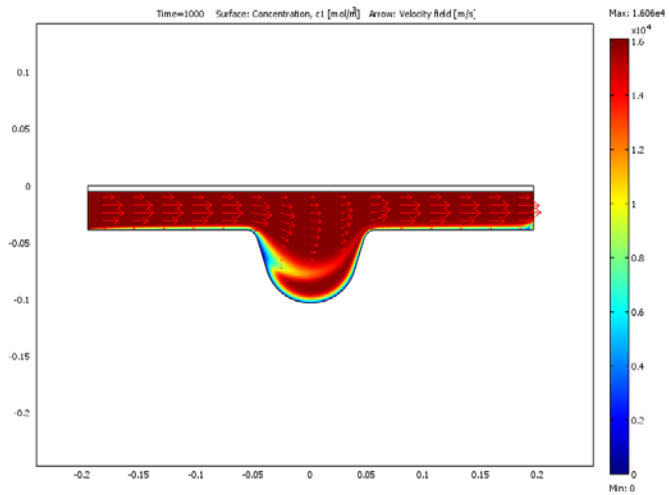
Niobium concentration is modeled as a function of convection and diffusion phenomena.

+ Chemical reaction with fluorine



High diffusion coefficient for fast growth of the viscous layer



EP modeled for sample geometries and different shape geometries.