European Commission

STRATEGY FOR THE MANAGEMENT OF NON CONVENTIONNAL LEGACY FUELS AT JRC-KA

Tools for a rapid characterization of fuels

Joint Research Centre

C. Nourry; J. Pravdova

Introduction

Construction of ITU (JRC Karlsruhe) started in 1963

1st Pu sample introduced in 1965

1st irradiated fuel introduced in November 1966

Fuel Matrix	Actinides and/or dopant	Reactor	Burn up
Oxides **Nitride** **Carbide** **Carbo-nitride** **Metal**	U+Pu ($\frac{Pu}{U+Pu}$ 10-24%) from U_{nat} to highly enriched Np, Am, Cm Additives Gd, Cr	HFR PHENIX RAPSODIE FR2 DFR SILOE BR2 HALDEN KNKII	From 0.5% to 13% FIMA

In 60 years JRC KA took part in many research program on irradiated fuels

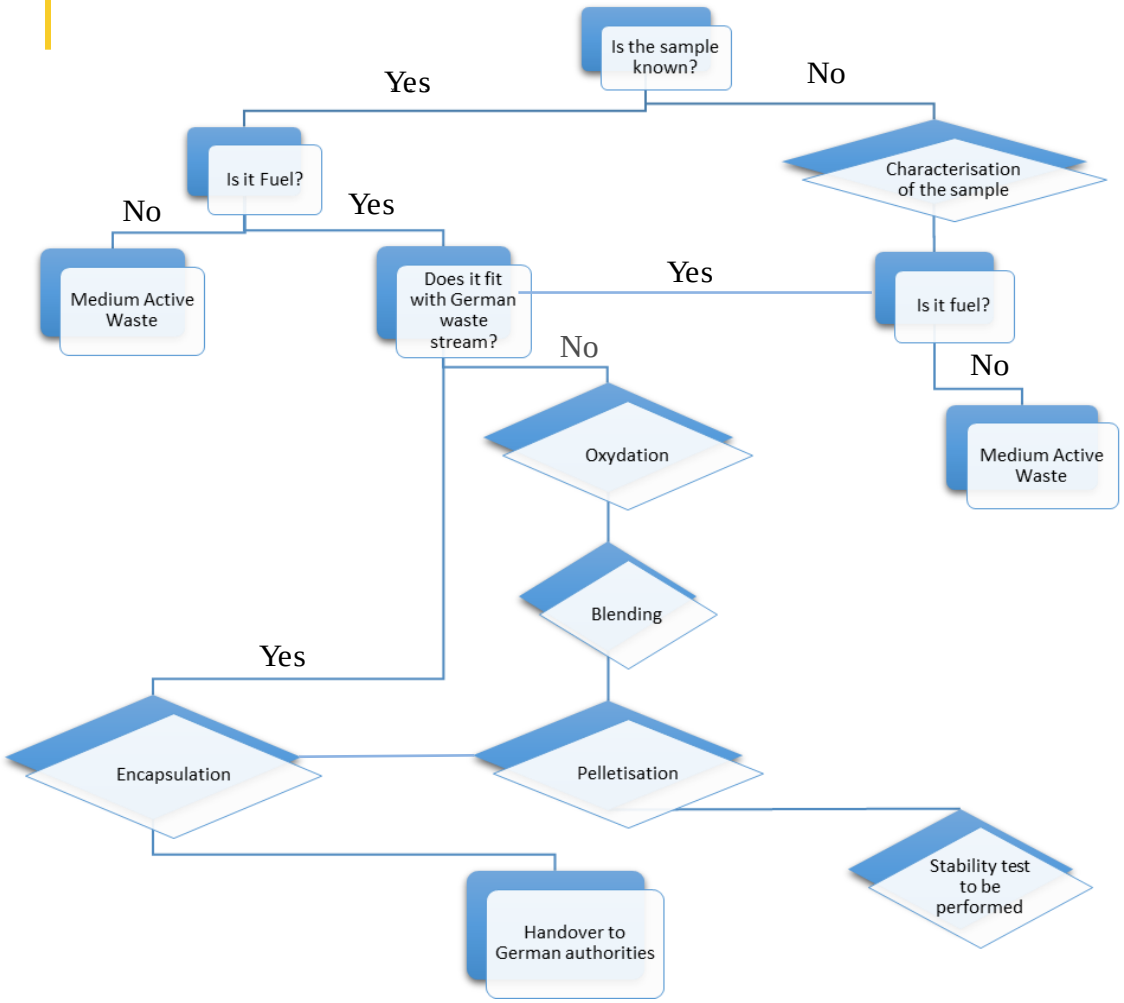
Inventory Reduction and Handover

Returning to legal owners

Transfer of ownership

Handover to German authorities after conversion

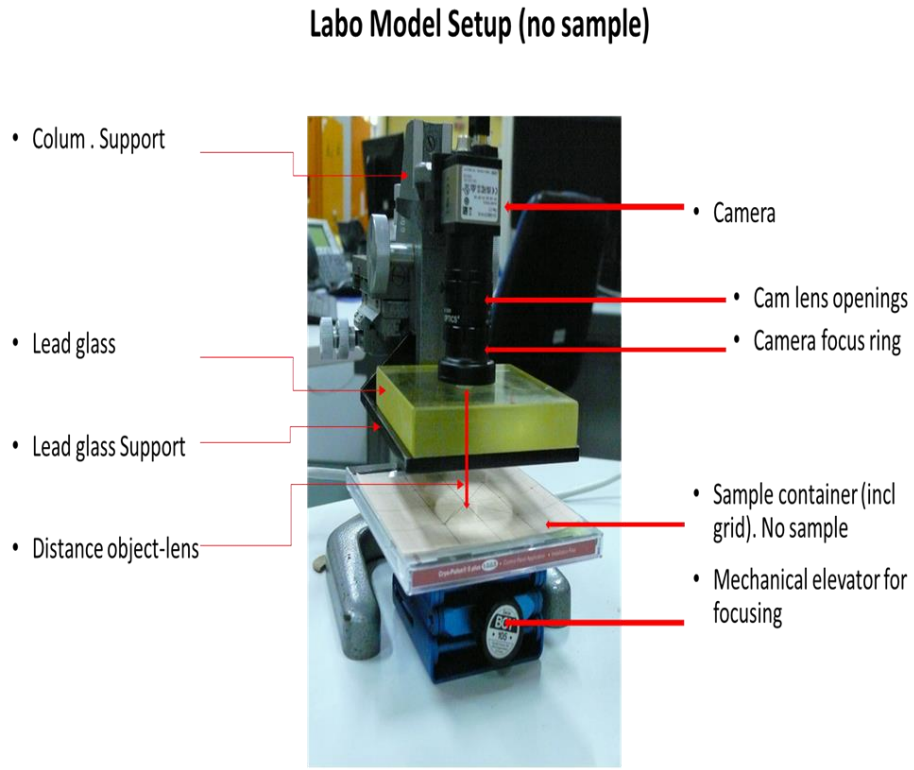
Process to convert samples



Unirradiated (U,Pu)C pellets (left) and powder produced after oxidation at 800°C (right)

Legacy fuel characterisation measurement bench

Technique used	Expected output
Balance + Dose rate	Discriminate between fuel and not (for the same mass fuel has a 100 time higher dose rate than cladding)
Optical dimensioning (camera combined to dimensioning software)	Discriminate between different type of reactors (phenix 5,4mm vs commercial reactors 8-10mm)
Portable LIBS	Discriminate between the matrix components (carbide, nitride, oxide, plutonium uranium)

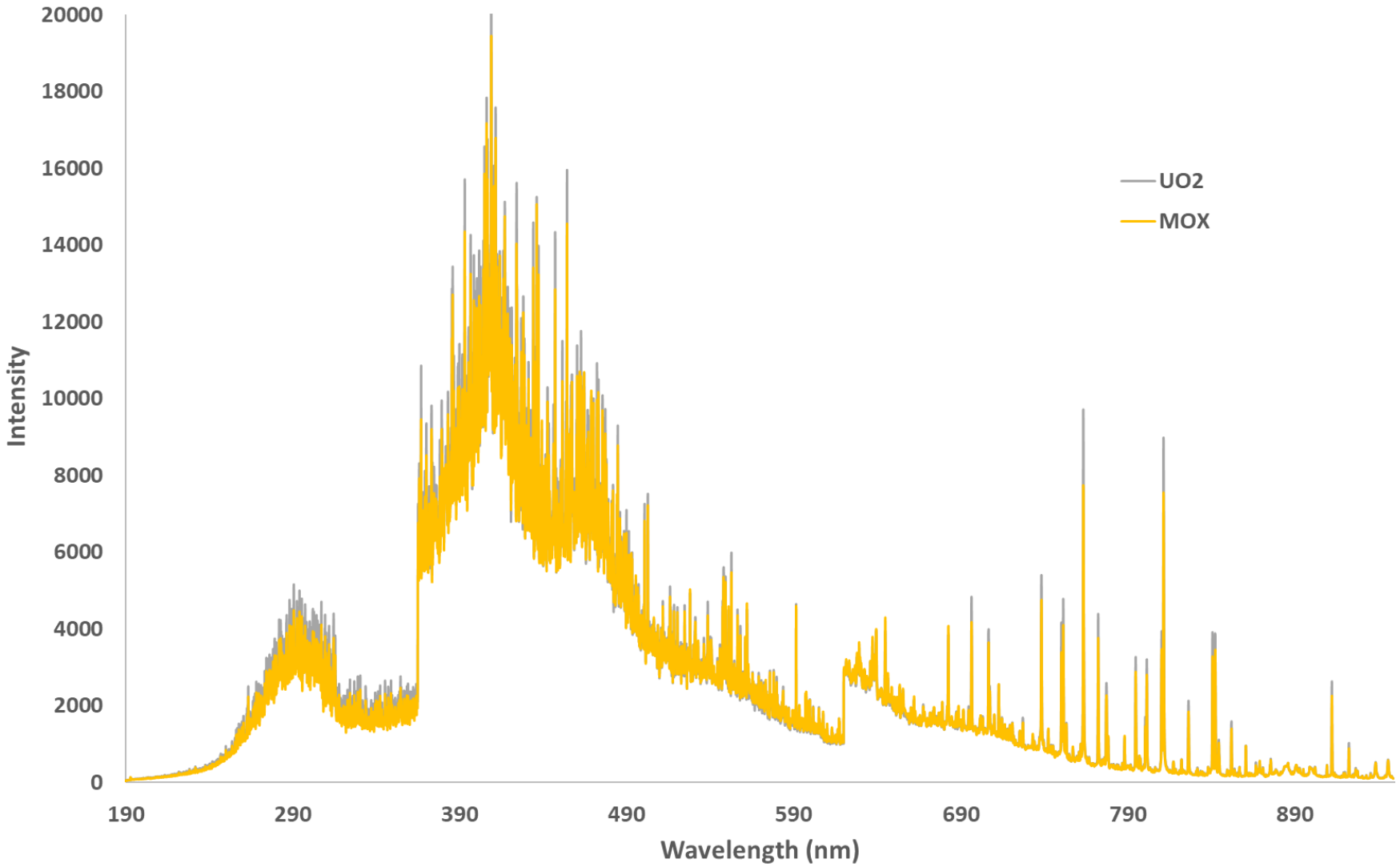


Detail of the instruments implemented in the measurement bench

Legacy fuel characterisation measurement bench

Portable Z-903 from SciAps company.
190-950 nm analytical range.
Resolution between 0,08nm to 0,2 nm.
50Hz
1064nm wave length.
< 100 µm spot

Legacy fuel characterisation: LIBS spectrum



European Commission

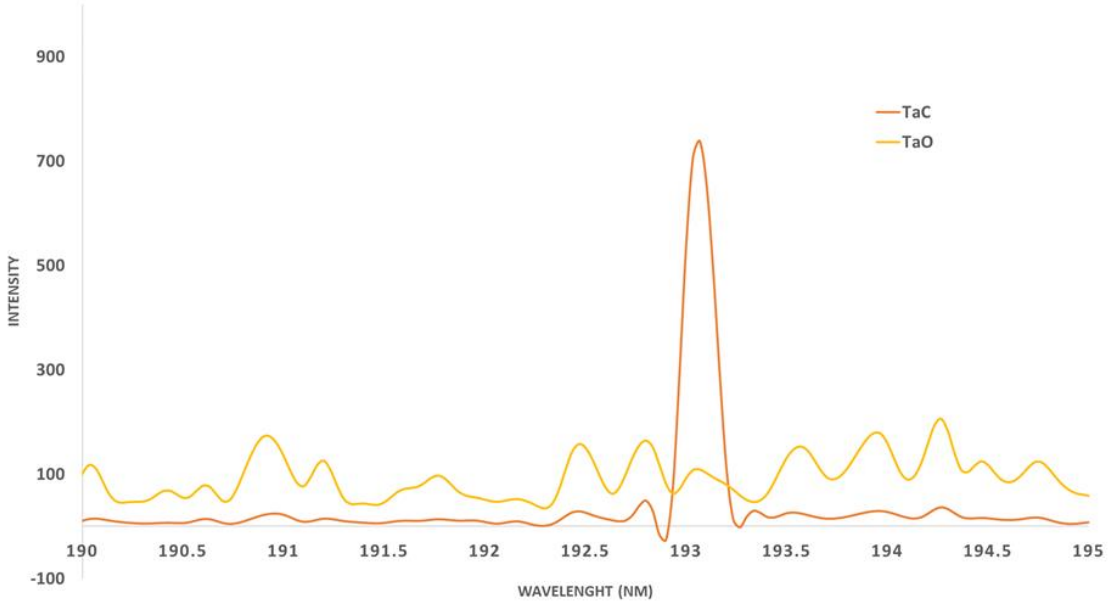
Legacy fuel characterisation: identification and quantification of C & O with LIBS

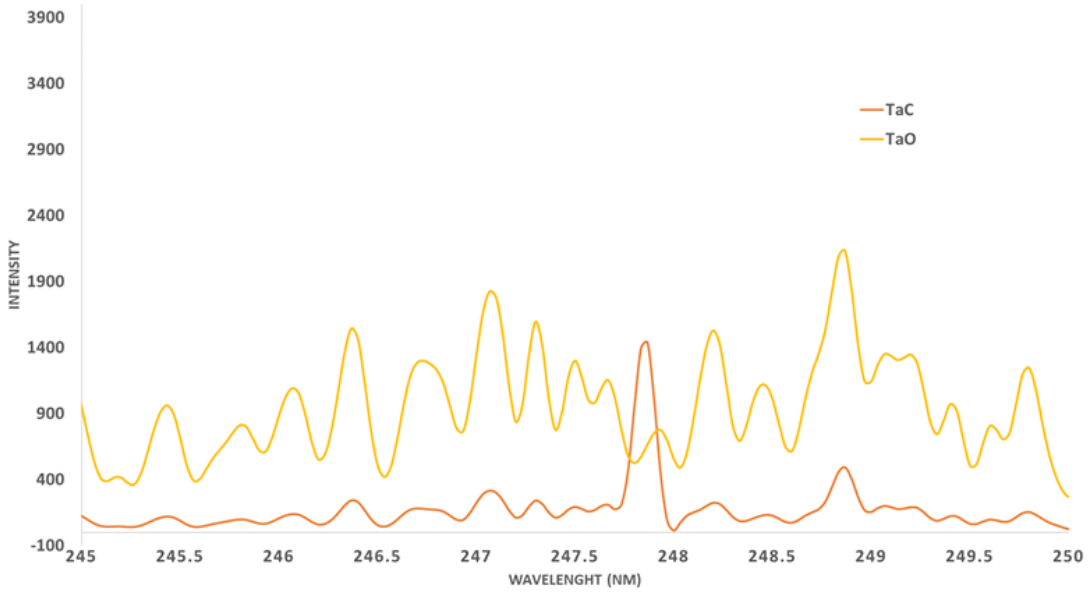
From the NIST database

Oxygen	Carbon
O I 777.194 nm O I 777.417 nm	C I 193.090 nm
O I 844.625 nm O I 844.636 nm O I 844.676 nm	C I 247.856 nm

Tests performed on TaC & TaO

Legacy fuel characterisation: identification and quantification of C & O with LIBS





ST database

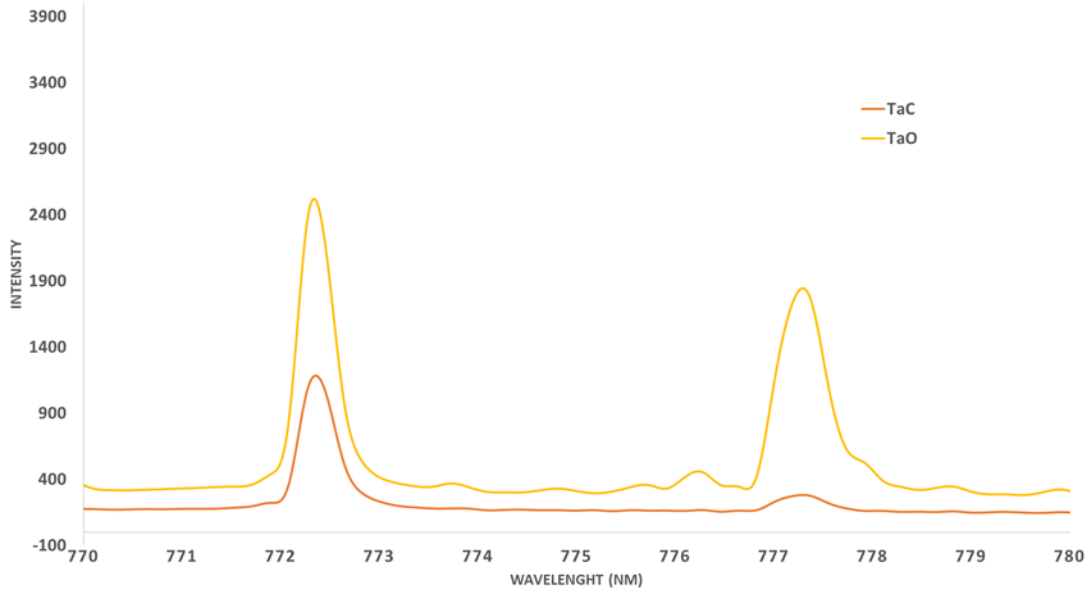
Carbon
C I 193.090 nm
C I 247.856 nm

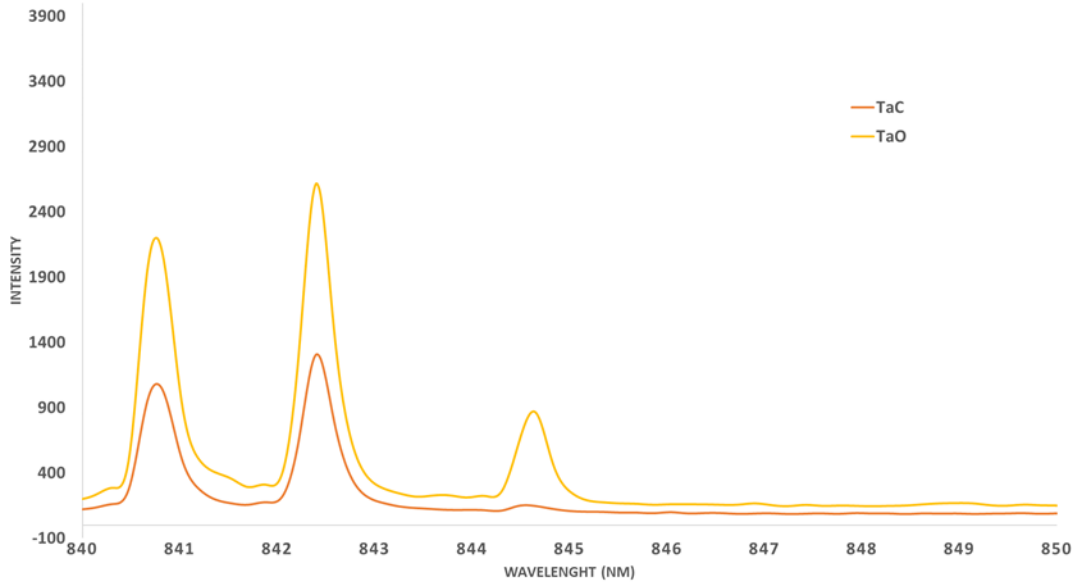
European Commission

Legacy fuel characterisation: identification and quantification of C & O with LIBS

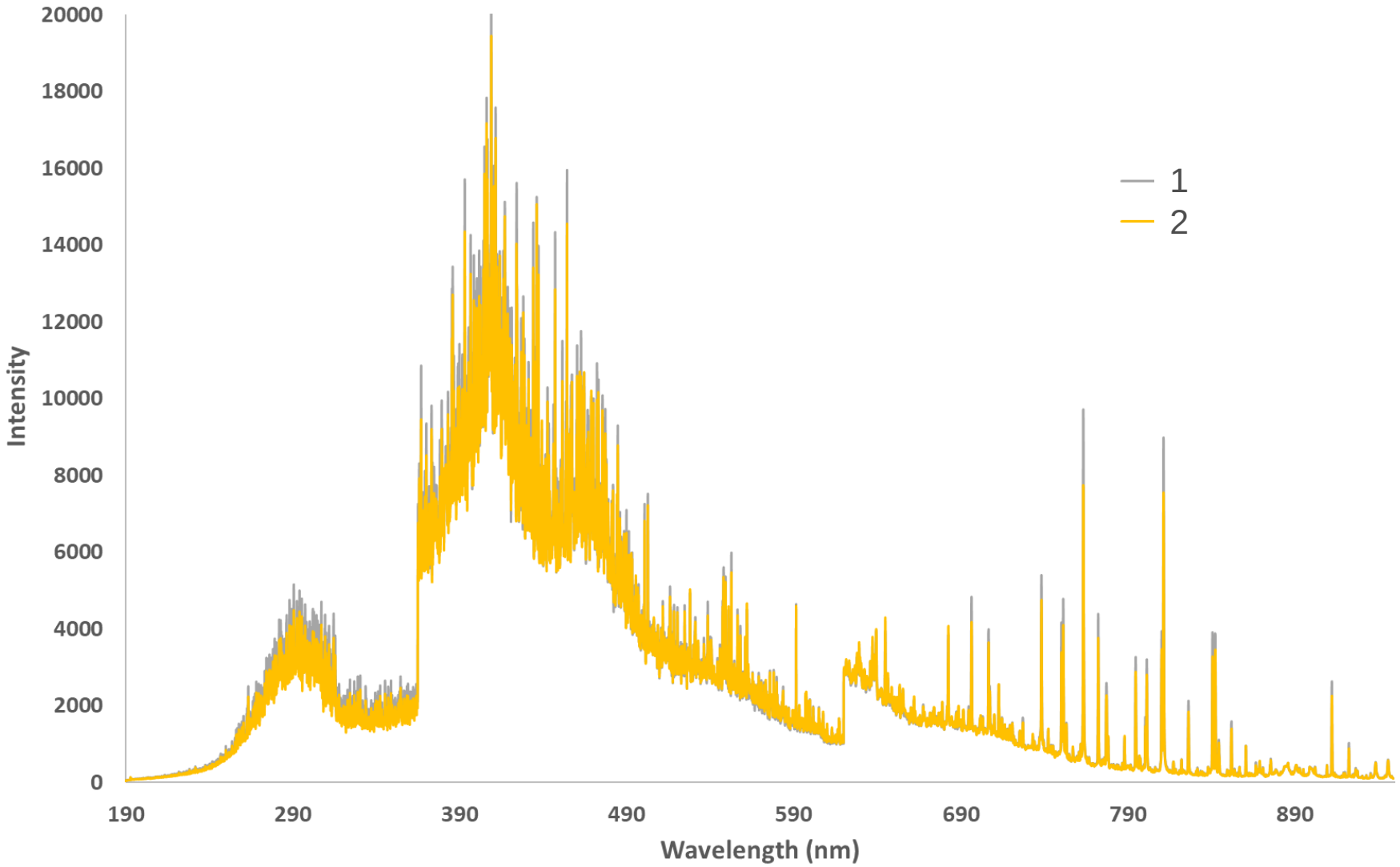
From the NI

Oxygen
O I 777.194 nm O I 777.417 nm
O I 844.625 nm O I 844.636 nm O I 844.676 nm



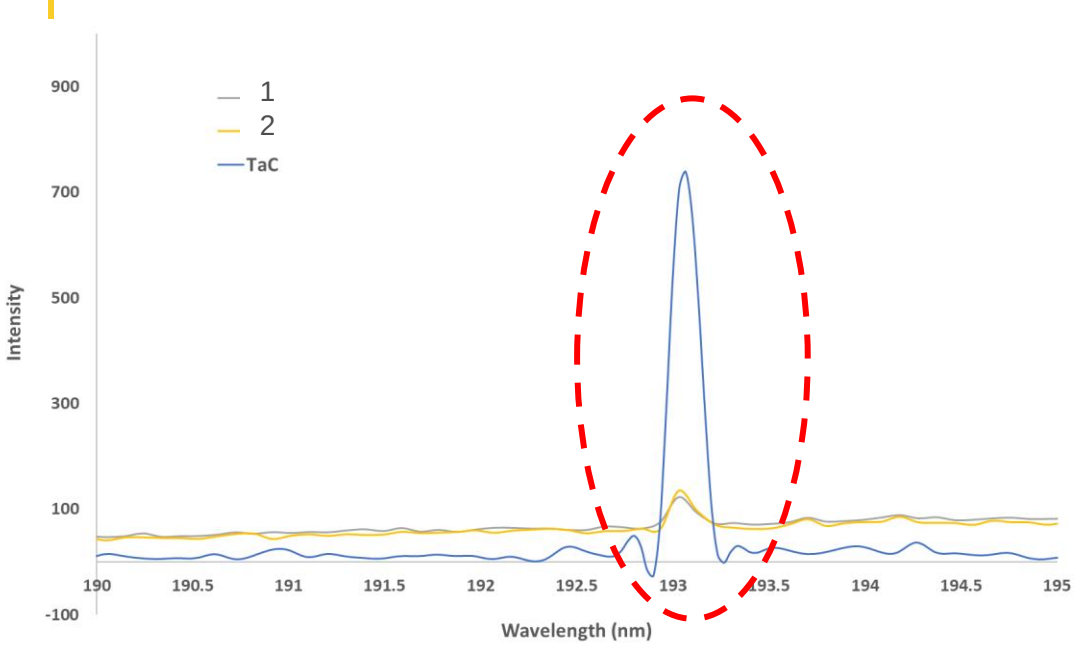


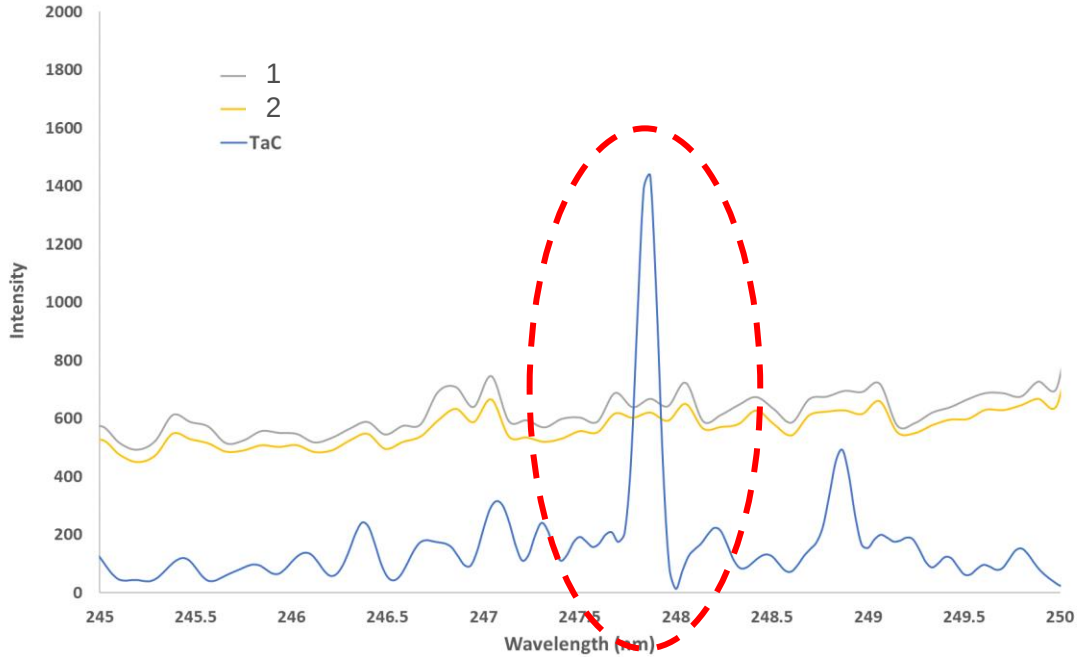
Legacy fuel characterisation: Use of LIBS to characterize the matrix

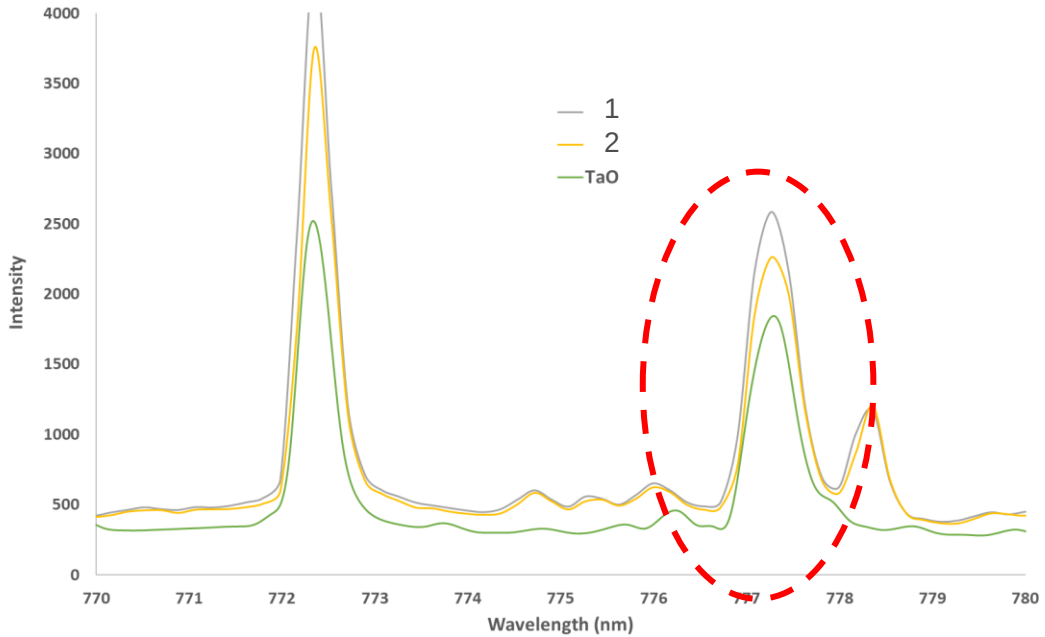


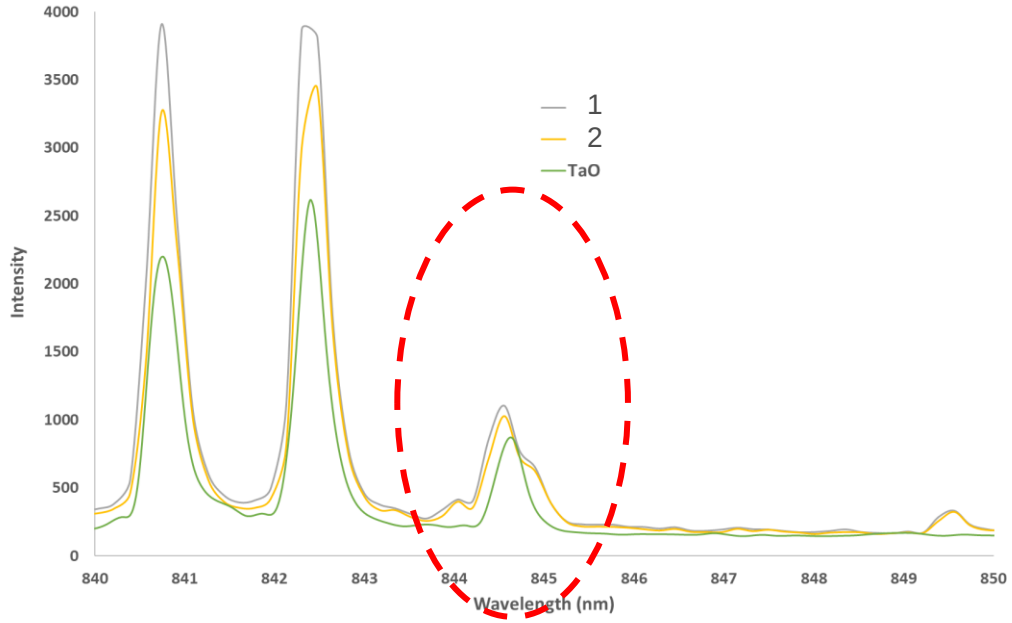
European Commission

Legacy fuel characterisation: Use of LIBS to characterize the matrix

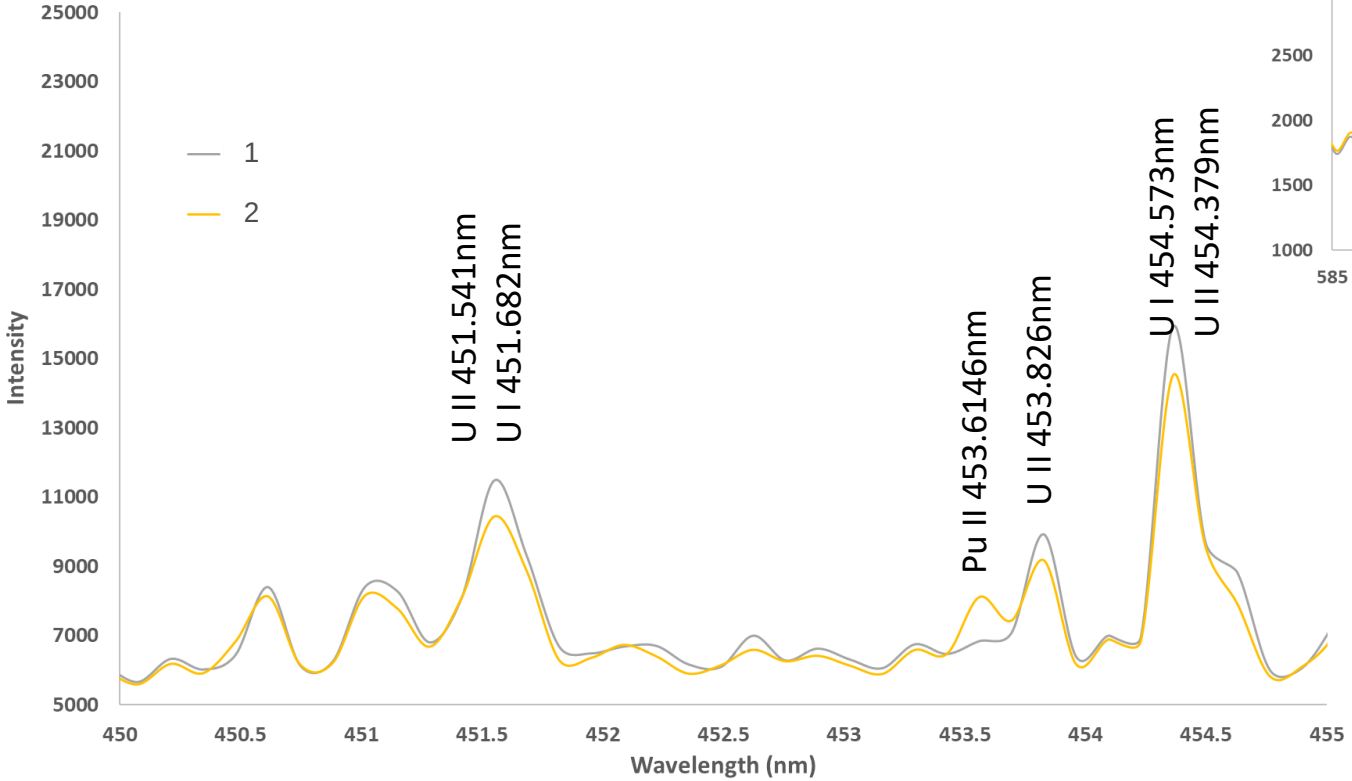


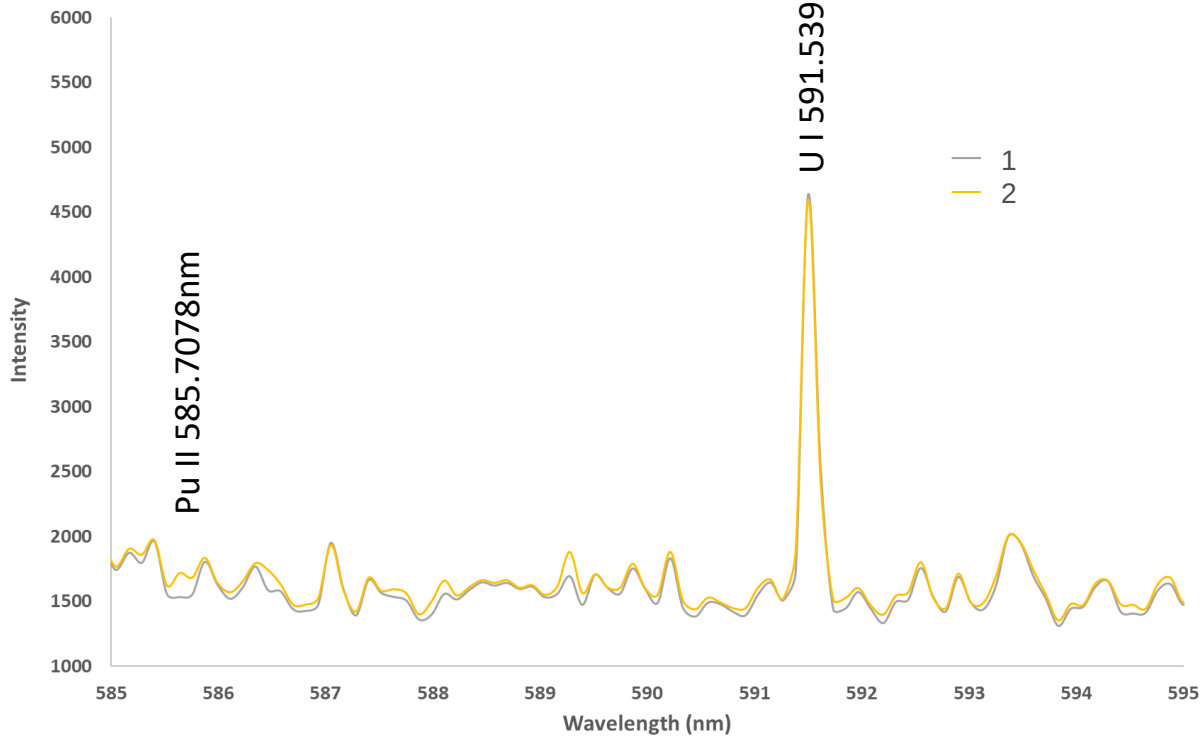






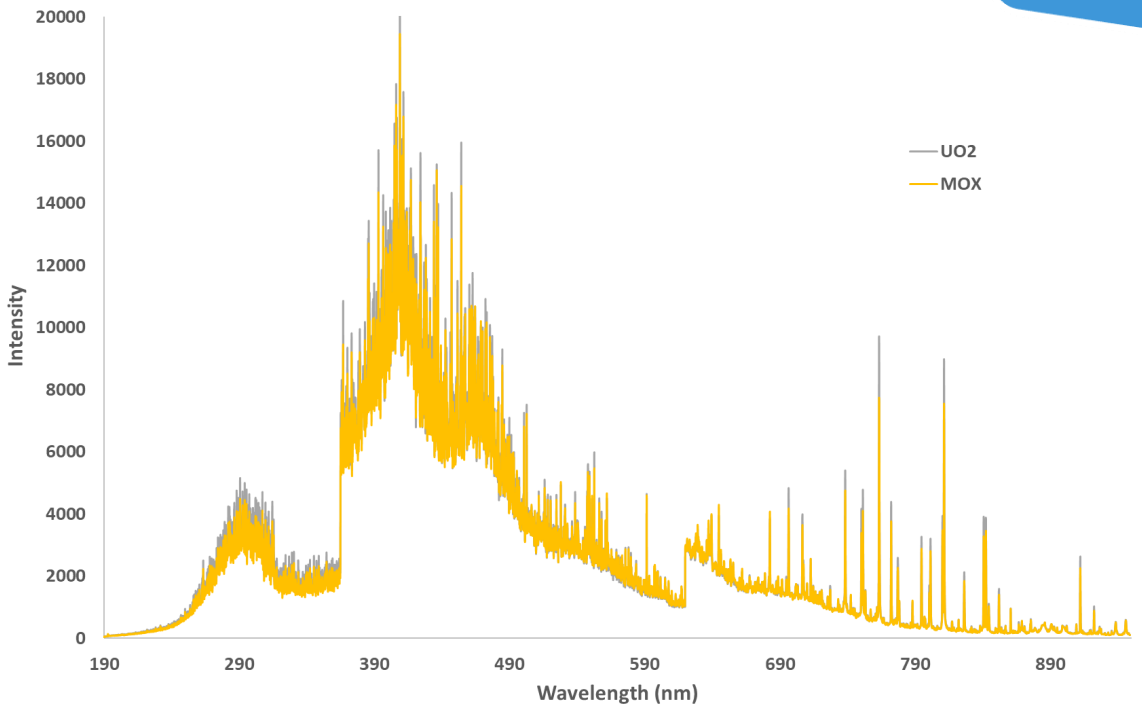
Legacy fuel characterisation: Use of LIBS to characterize the matrix





European Commission

Legacy fuel characterisation: Use of LIBS to characterize the matrix



1&2 are oxydes

1 contains only U
2 contains U & Pu

$1=UO_2$
2=MOX

European Commission

Conclusion

JRC Karlsruhe is developing characterisation tools.

In the meantime

- the return to the legal owners
- ownership transfer to interested partners

Second phase

- fuel modifications (R&D required)
- handover to German authorities

Thank you

EU Science Hub
joint-research-centre.ec.europa.eu

European Commission