Development of Cr-Si alloys and compatible Thermal Barrier Coatings

High Entropy Oxides as new Thermal Barrier Coatings

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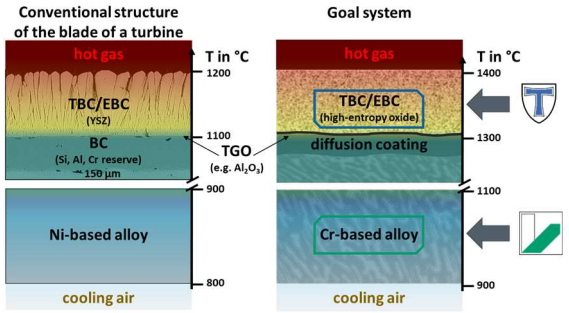


YSZ: Yttria Stabilized Zirconia – BC: Bond Coat – TGO: Thermally Grown Oxide

Goals of the joint project

1

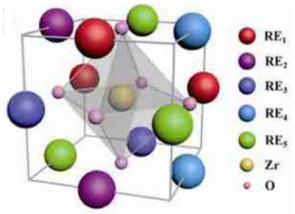
- Allow higher process temperature in gas turbines
- Reduce the overall weight of the system (reduce material and/or use of lighter components)
- Reduce the use of rare elements
- Improve the performances of the state-of-the-art system (Ni-alloy with YSZ)

- **Structure of the joint project:**
  - Development of High Entropy Oxides (HEOs) as new Thermal Barrier Coating (TBC) and/or Environmental Barrier Coating (EBC)
  - Development of Cr-Si alloys as new substrate (Partner University of Bayreuth)

Pyrochlores[1,2]

2

- $A_2B_2O_7$
- A site (3+)
  - 8-fold coordinated
  - Usually rare earths (RE)
- B site (4+)
  - 6-fold coordinated
  - Usually Zr (TBC) or Si (EBC)



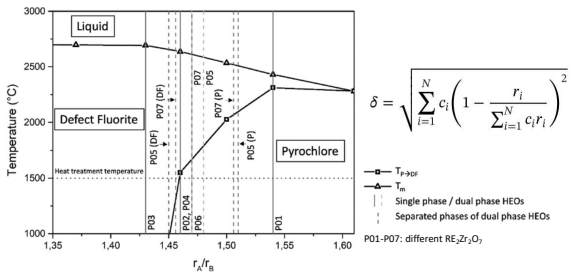
High Entropy Oxides (HEOs)

3

"Solid solutions of five or more cations or anions sublattices with a high configuration entropy"[3]

- **RE zirconates promising[1,3,4]**
  - Good thermal stability
  - Low thermal conductivity
  - High melting point
  - High variability
  - Tuneable coefficient of thermal expansion

- **Foreseen the outcome[5]**
  - Crystal structure: affected by the ionic radii ratio (r_A/r_B)
  - Phase purity: affected by the atomic size difference (δ)



Conclusions

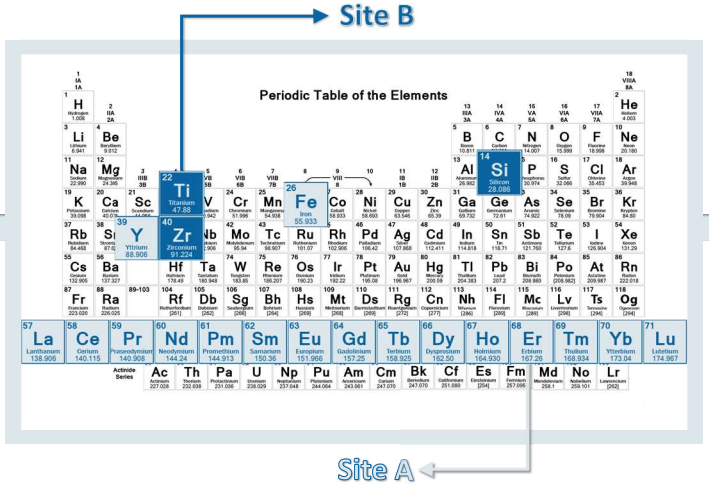
5

- New HEOs ceramics will be developed
- Their physico-chemical properties will be studied
- Their behaviour as a TBC/EBC materials will be investigated
- ➢ New system to improve the performances of the gas turbines

Working plan

4.B

- **Zirconium**
  - Excellent TBC behaviour
- **Titanium**
  - Fill knowledge gap
  - Lighter and more easily available than Zr
- **Silicon**
  - Cheaper, lighter and more easily available than Zr
  - Enhance corrosion resistance
- **Mix Zr/Ti/Si**
  - Increase the disorder
  - Merge different properties



- **Rare earth metals**
  - Excellent TBC behaviour
  - Correlation RE and crystal structure
  - Photoluminescence properties and thermal emittance (side project)
- **Transition metals**
  - Cheaper, lighter, more easily available

4.A

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