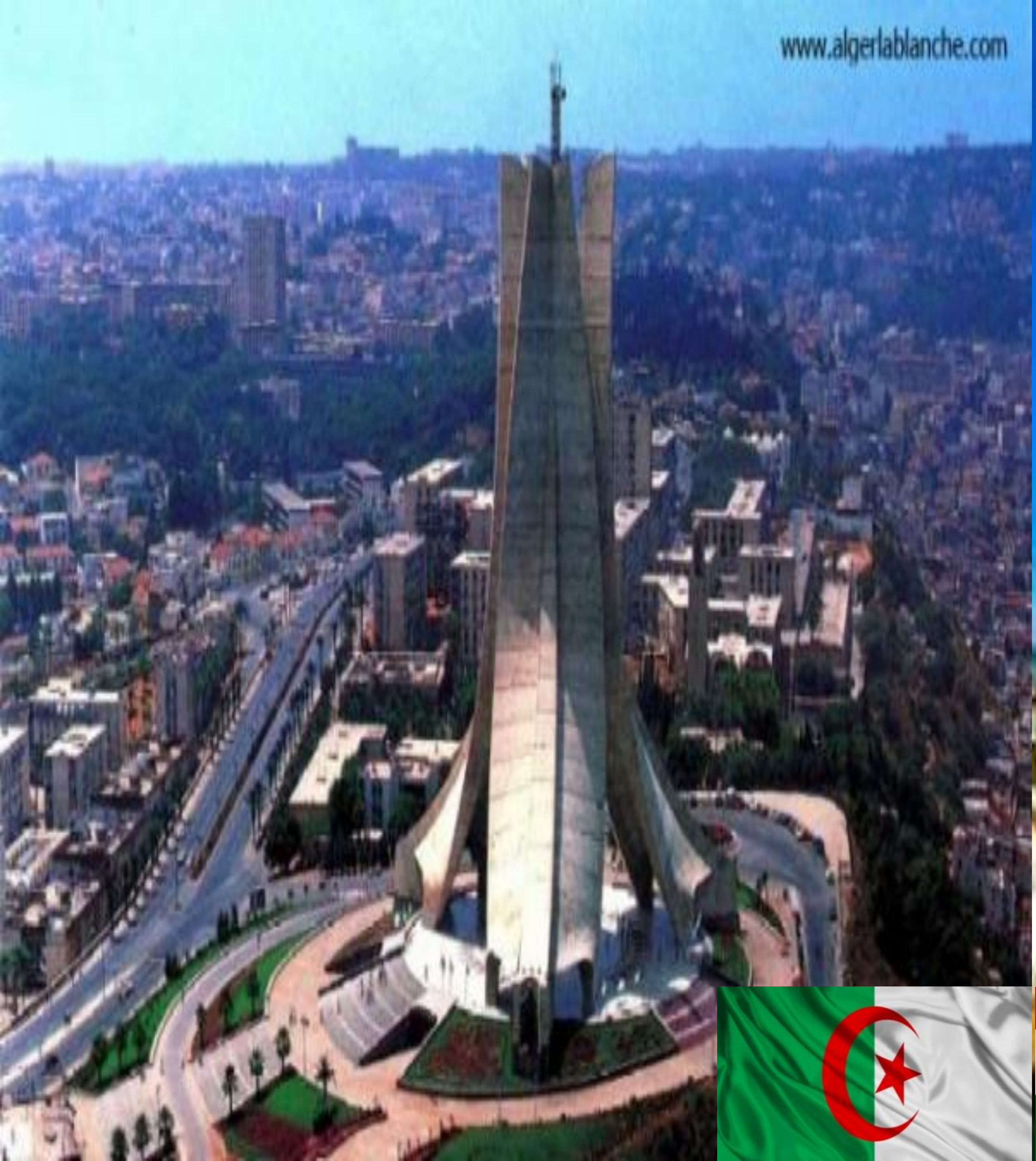
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Preparation and characterization of nanostructured oxide dispersion strengthened steels (ODS)

Ben Zine Haroune Rachid

(1. semester presentation)

Supervisors: Dr. Csaba Balázsi (Bay Zoltán Ltd.)
Dr. Katalin Balázsi (MTA EK)

Óbuda University, 2016. 01. 20

CONTENT

- Introduction

  The Idea of work

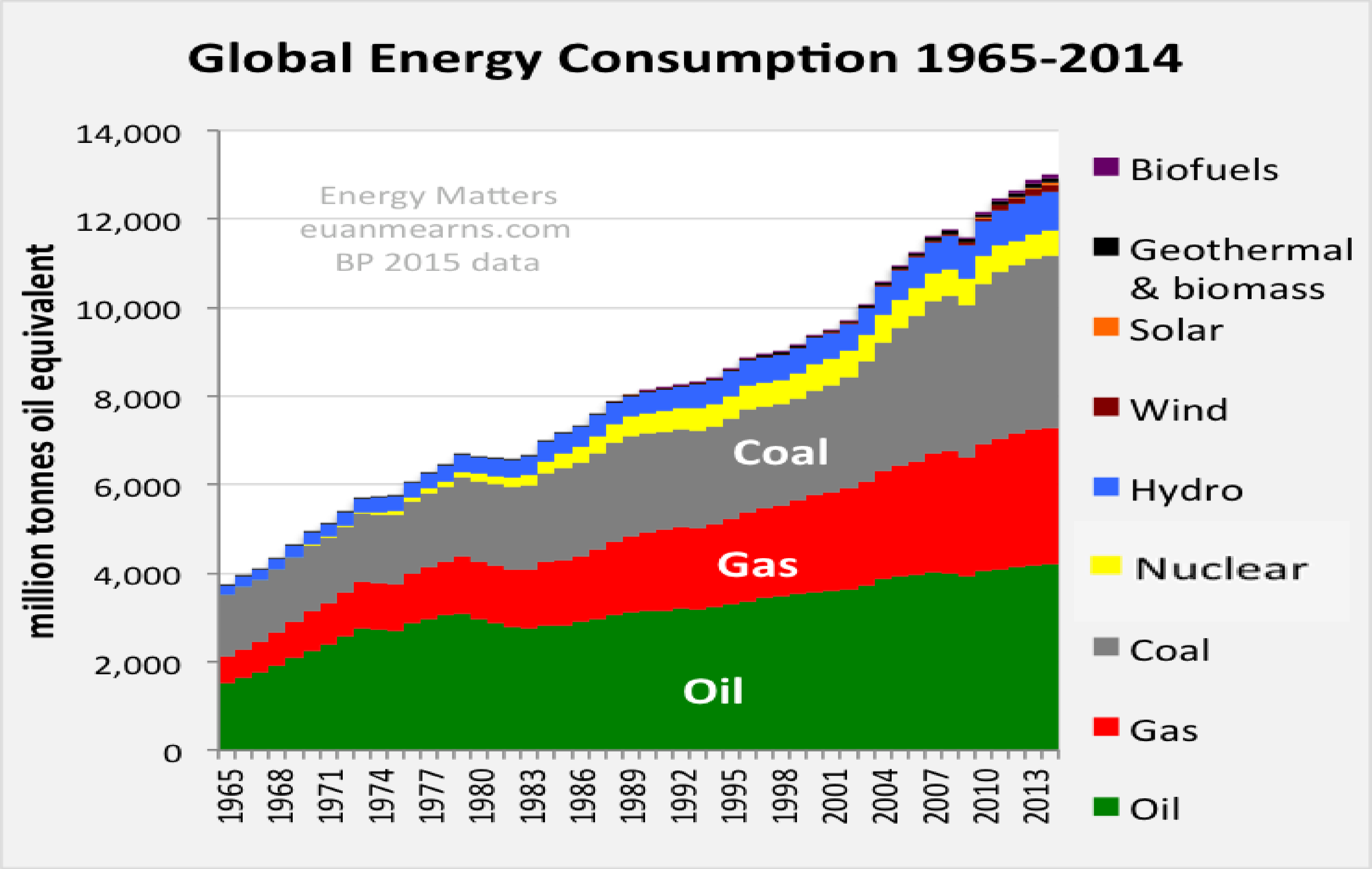
  Why ODS?

- Results of the actual semester
- Plans for the future work

Ben Zine Haroune Rashid: Preparation and characterization of ODS

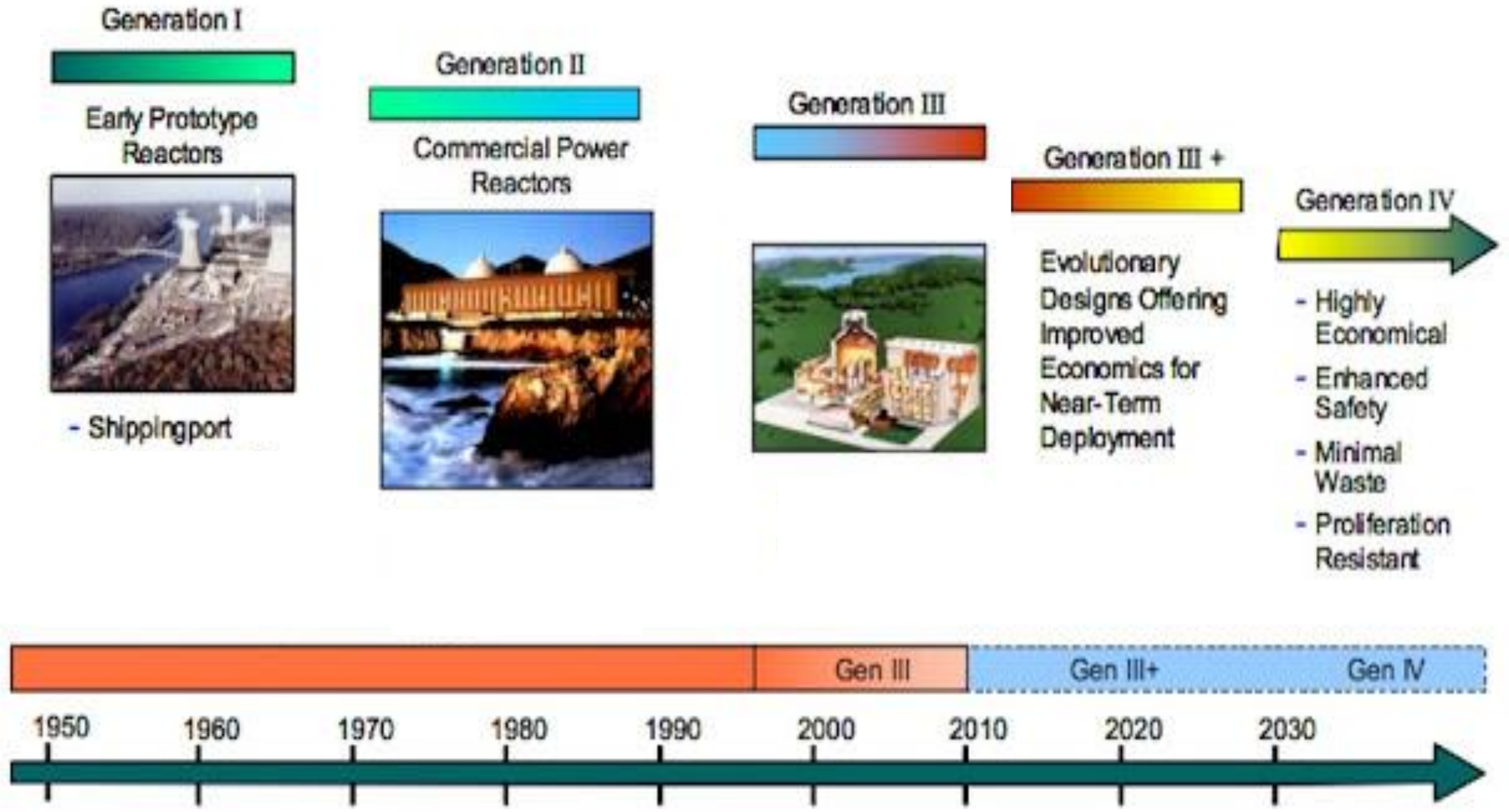
Óbuda University, 2016. 01. 20

But …

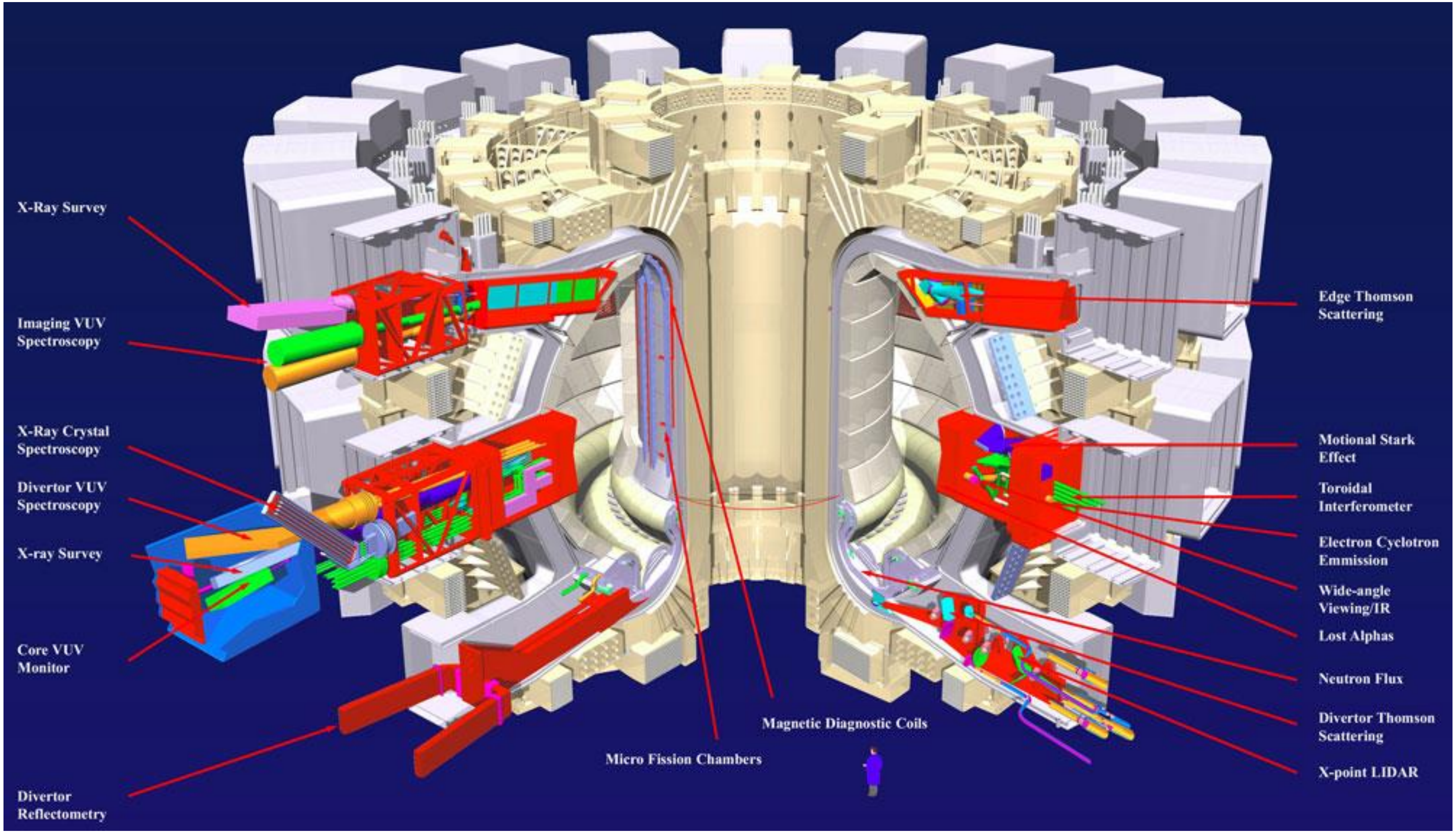

Global Energy Consumption 1965-2014
Energy Matters
euanmearns.com
BP 2015 data
million tonnes oil equivalent
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
2013
Coal
Gas
Oil
Biofuels
Geothermal & biomass
Solar
Wind
Hydro
Nuclear
Coal
Gas
Oil

IDEA of WORK

Development of environmentally sound technologies for producing electric energy will require the use of new generation intelligent stuctural materials in the future.



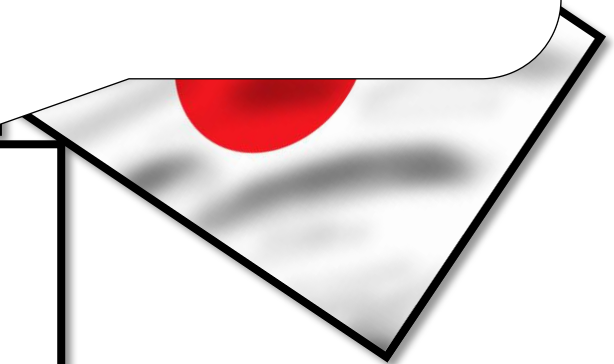
~120 Mpa



1000C°

500C°

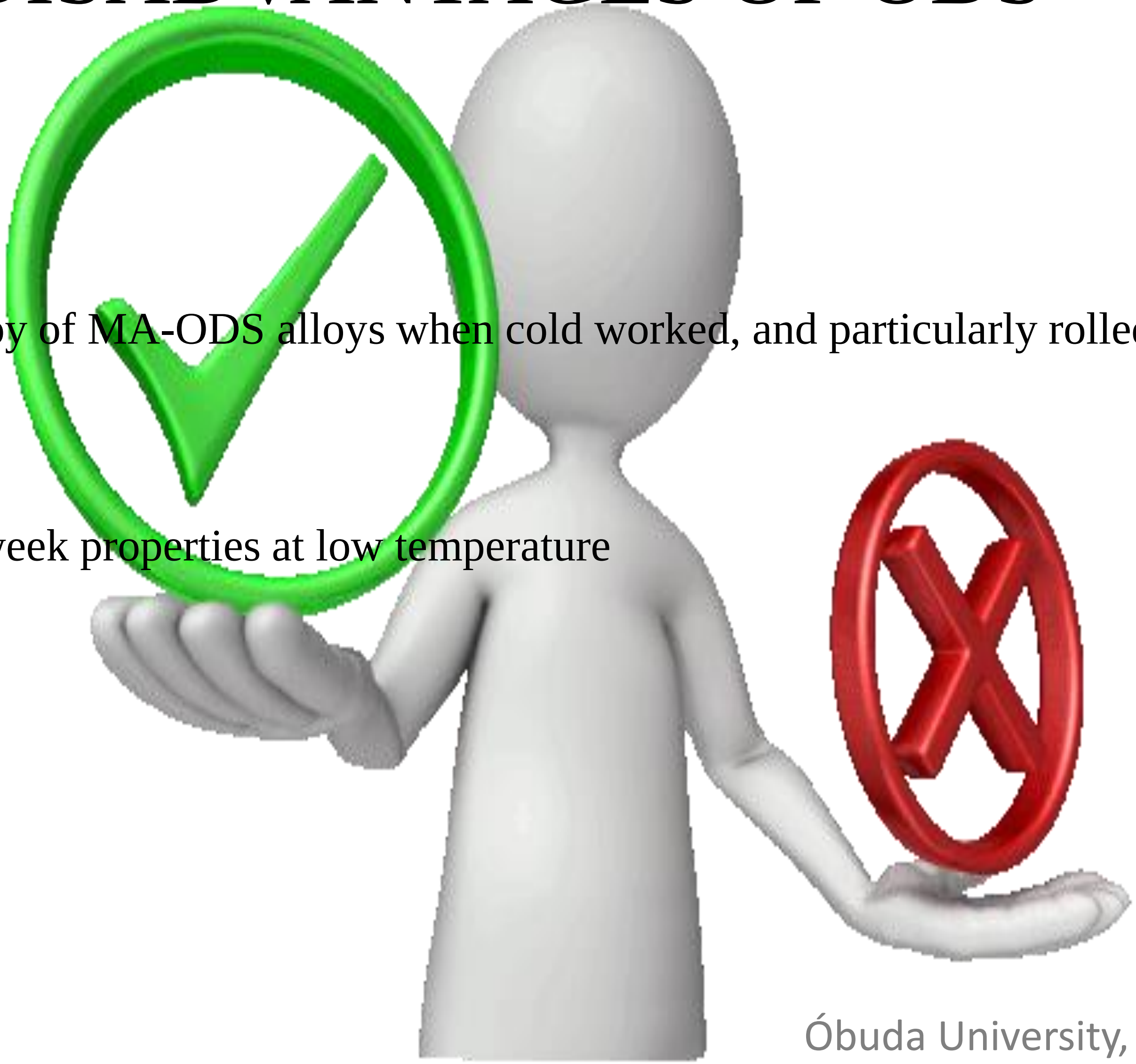
Oxide-dispersion strengthened steels (ODS)[1-10] have attracted attention for advanced nuclear applications such as fast and fusion reactors. [11]



ADVANTAGES OF ODS

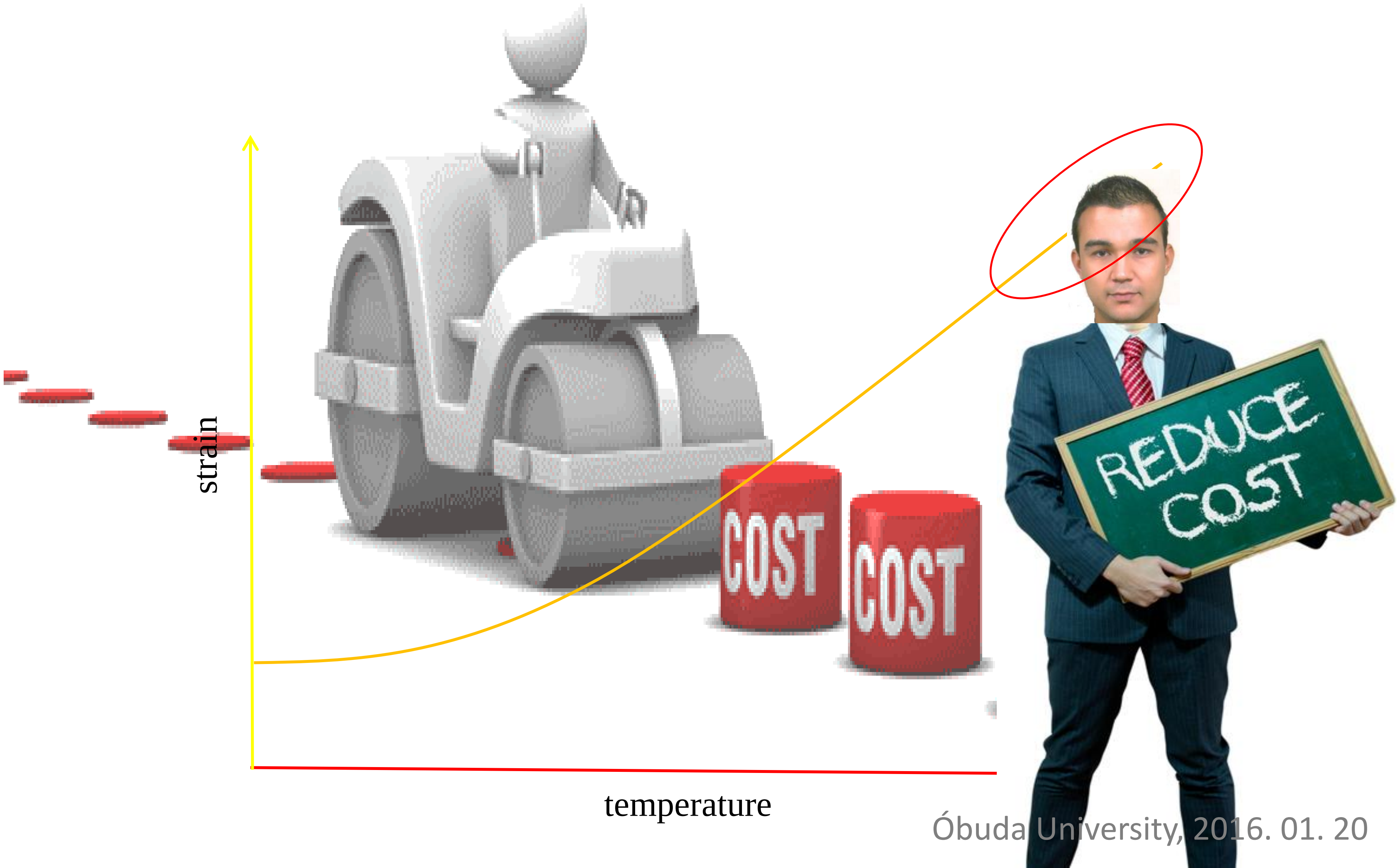
- ✓- their strength at high temperatures (>1000K)
- ✓- relatively lightweight
- ✓- Less expensive
- ✓- low swelling and almost no embrittlement with exposure to high energy neutrons
- ✓- high resistance to oxidation and nitration

DISADVANTAGES OF ODS



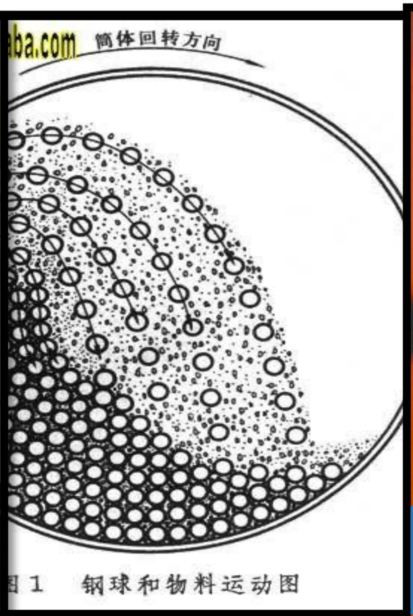
- - The anisotropy of MA-ODS alloys when cold worked, and particularly rolled into tubes [12]
- - Relatively week properties at low temperature

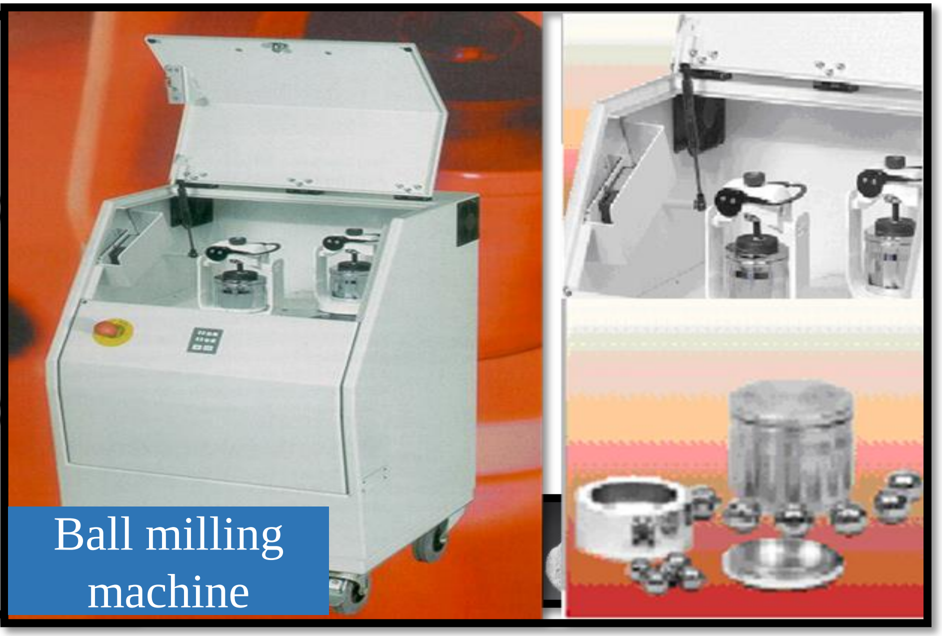
The goal of the work



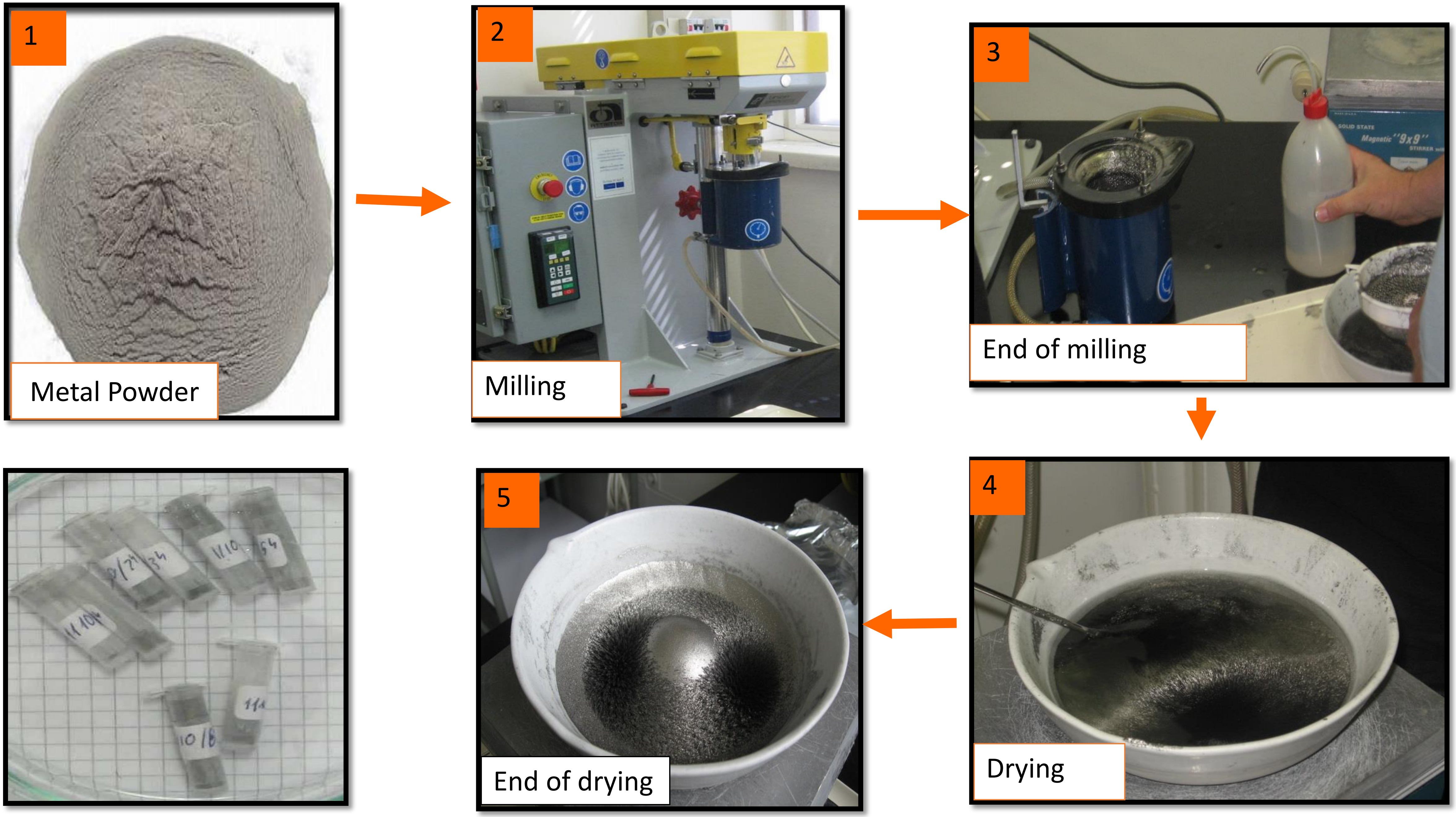
The basic idea of the work

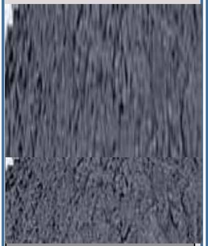
Attrition milling machine





Ball milling machine


1
Metal Powder
2
Milling
3
End of milling
4
Drying
5
End of drying



Short summary about the semester

Knowledge management (literature survey, design and manufacture of equipments)

1- passing all the taken subjects successfully

2- critical review of literatures about ODS

3- design a compaction Die for Gleeble 3800

4- Ordering the steel powder from Höganäs

The structures of the power plants are influenced by complex effects: high operating temperature, corrosion, mechanical stresses and neutron radiation.

The ferritic/martensitic alloys are though enough in neutron radiation, and the mechanical properties can be further improved for example by the application of mechanical alloying.

Mechanical alloying technique is able to produce **fine grain microstructure (nanostructure)**, or metastable alloys, and addition of nanometer-scale ceramic particles (e.g. Yttrium-oxide) improve greatly the strength and creep properties by blocking the dislocations movements in the ferrite.

The mechanical alloying technique, beside dispersing ceramic particles in the steel, is able to produce such alloys which can hardly made by traditional metallurgy, like the alloys of metals with limited miscibility or **large difference in the melting temperature.**

Plans for the future work

Knowledge management (literature survey, design and manufacture of equipments, Publications)

1- the experimental work in Bay Zoltan using Al_2O_3
2- Start the experimental work in HAS using the Y_2O_3
3- Spark plasma sintering (SPS)
4- Microstructure studies (TEM, HREM, XRD, EDS, XPS…)
5-Mechanical properties (3 and 4-point bending strength, hardness…)
6- publish an article about ODS (understanding of previous studies)
7- participate in International Workshop in Manchester
8- publish an article about the experimental work

THANK YOU FOR YOUR ATTENTION

“You were born original „

don’t die a copy”

[1] Development of oxide dispersion strengthened ferritic steels for Fusion ,D.K. Mukhopadhyay , F.H. Froes , D.S. Gelles , Journal of Nuclear Materials 258±263 (1998) 1209±1215

[2] Oxide dispersion-strengthened steels: A comparison of some commercial and experimental alloys R.L. Klueh, J.P. Shingledecker, R.W. Swindeman, D.T. Hoelzer, Journal of Nuclear Materials 341 (2005) 103–114

[3] A review of refractory metal alloys and mechanically alloyed-oxide dispersion strengthened steels for space nuclear power systems Mohamed S. El-Genk , Jean-Michel Tournier, Journal of Nuclear Materials 340 (2005) 93–112

[4] Hydrogen-induced crack nucleation in tensile testing of EUROFER 97 and ODS-EUROFER steels at elevated temperature Evgenii Malitckii, Yuriy Yagodzinskyy, Hannu Hanninen, Journal of Nuclear Materials 466 (2015) 286-291,

[5] Investigation of microstructure changes in ODS-EUROFER after hydrogen loading O.V. Emelyanova, M.G. Ganchenkova, E. Malitskii, Y.N. Yagodzinskyy, M. Klimenkov, V.A. Borodin, P.V. Vladimirov, R. Lindau, A. Moslang, H. Hanninen, Journal of Nuclear Materials (2015) 1-5

[6] Irradiation effects in oxide dispersion strengthened (ODS) Ni-base alloys for Gen. IV nuclear reactors Naoko Oono ,Shigeharu Ukai, Sosuke Kondo, Okinobu Hashitomi, Akihiko Kimura, Journal of Nuclear Materials 465 (2015) 835-839

[7] Microstructural changes and void swelling of a 12Cr ODS ferriticmartensitic alloy after high-dpa self-ion irradiation Tianyi Chen, Eda Aydogan, Jonathan G. Gigax, Di Chen, JingWang, XuemeiWang, S. Ukai, F.A. Garner, Lin Shao, Journal of Nuclear Materials 467 (2015) 42-49

[8] Nanoscale lamellar γ/γ′ structure and preferred distribution of oxide particles in a new ODS superalloy, S.M. Seyyed Aghamiri, HR.Shahverdi, S.Ukai, N.Oono, M.Nili Ahmadabadi, T.Okuda, Materials Letters161(2015) 568–571,
[9] Processing and microstructure characterisation of oxide dispersion strengthened Fe–14Cr–0.4Ti–0.25Y2O3 ferritic steels fabricated by spark plasma sintering, Hongtao Zhang and al, Journal of Nuclear Materials 464 (2015) 61–68,
[10] Structure and mechanical properties of FeeNieZr oxide-dispersionstrengthened (ODS) alloys, K.A. Darling ,M. Kapoor, H. Kotan, B.C. Hornbuckle, S.D. Walck, G.B. Thompson, M.A. Tschopp, L.J. Kecskes, Journal of Nuclear Materials 467 (2015) 205-213
[11] Mohamed S. El-Genk *, Jean-Michel Tournier A review of refractory metal alloys and mechanically alloyed-oxide dispersion strengthened steels for space nuclear power systems, Journal of Nuclear Materials 340 (2005) 93–112
[12] K. Balázsi, Cs. Balázsi and al NANOSTRUCTURED OXIDE DISPERSED STRENGTHENED STEELS: PREPARATION AND INVESTIGATION, Powder Metallurgy Progress, Vol.10 (2010), No 4