WAYS TO REDUCE CO2 FOOTPRINT
USING ELECTRIC HEATING MATERIALS

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SHTE Värmebehandlingskonferens

Bålsta, 2022-05-04

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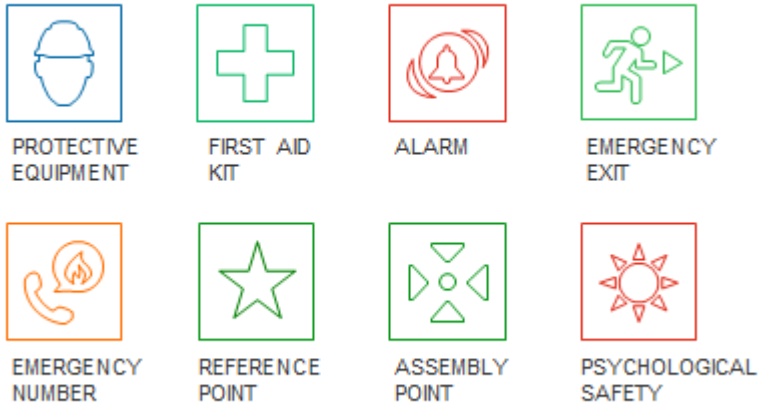
SAFETY FIRST

Kanthal's objective is zero harm to our people, the environment we work in, our customers and our suppliers.



OUTLINE

- Background
  - Kanthal and electric heating materials
- Reducing CO_2
  - Electrification of heating
  - Enabling of green technology

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Founded in 1931 by metallurgist
Hans von Kantzow in Hallstahammar

Wire and strip for electric heating elements

WHAT'S WEST OF VÄSTERÅS?

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Founded in 1931 by metallurgist
Hans von Kantzow in Hallstahammar

Wire and strip for electric heating elements

Success built on his new FeCrAl alloys

The Success: FeCrAl vs. Existing NiCr

- Forms aluminium oxide
  - **Much** more protective
  - Higher temperatures
  - Longer life
  - Sulfidizing/Carburizing, No problem
- High and constant electric resistivity
- No nickel – Cost benefit

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The Success: FeCrAl vs. Existing NiCr

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Nikrothal®

Both types still useful

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MOST IMPORTANTLY: **ELECTRIC** HEATING

- Replaces burning of oil/gas
- Advantages:
  - Environmental
  - Process quality
  - Safety

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WHY ELECTRIFY THERMAL PROCESSES?

ENVIRONMENTAL

- Green electricity → Green heating
- BUT! Even if fossil power – Better in total
  - Higher efficiency at big power plants
  - Electric ~95–98% efficiency

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WHY ELECTRIFY THERMAL PROCESSES?

QUALITY

- Temperature control
  - Control over ramping
  - Exact
  - Uniform
  - Repeatable
- Clean
  - No combustion products
- Reduced Maintenance

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WHY ELECTRIFY THERMAL PROCESSES?

SAFETY

- No gas pipes, fuel storage
  - Explosion risk eliminated
  - Fire risk minimal
- Exhaust gases – None
- Cooler working environment
- Silent!
  - Gas burners can be 100dB+
  - Easier communication

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EXAMPLES OF ELECTRIFICATION

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OVAKO – VARIOUS FURNACES/PROCESSES

TUBOTHAL HEATERS

- 14 roller hearth furnaces electrified
- Advantages:
  - Estimated CO_2 savings of 1400–2000 tons/year
  - Improved quality – Uniform heating, better control
  - Reduced maintenance costs
  - Improved work environment (silent, cool)
  - No combustion emissions of CO_2, NO_x, CO

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HYBRIT – COKE TO HYDROGEN

GAS HEATED HYDROGEN TO ELECTRICALLY HEATED

- Reduce iron ore using hydrogen instead of coke
- Heated hydrogen needed
- Fossil free --> Need electric heating

- Kanthal working on heating solution
- Smaller ~250 kW heater tested first
- Target gas temperature: 1000 °C
- Full-scale heater if successful: 1 MW

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KANTHAL – PIT FURNACE

KANTHAL SUPER ELEMENTS

- Heating of ingots and billets up to 1300 °C
- Elements of Molybdenum-Disilicide ($MoSi_2$)
  - For *very* high temperatures
  - Furnace temperature up to 1700–1800 °C possible
- Years between maintenance

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ENABLING GREEN TECHNOLOGY

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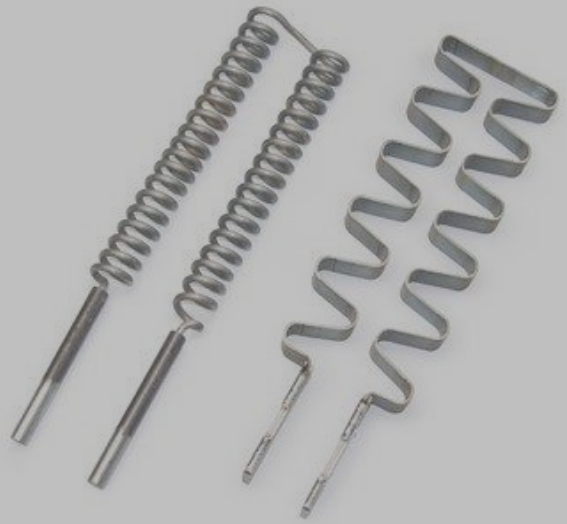

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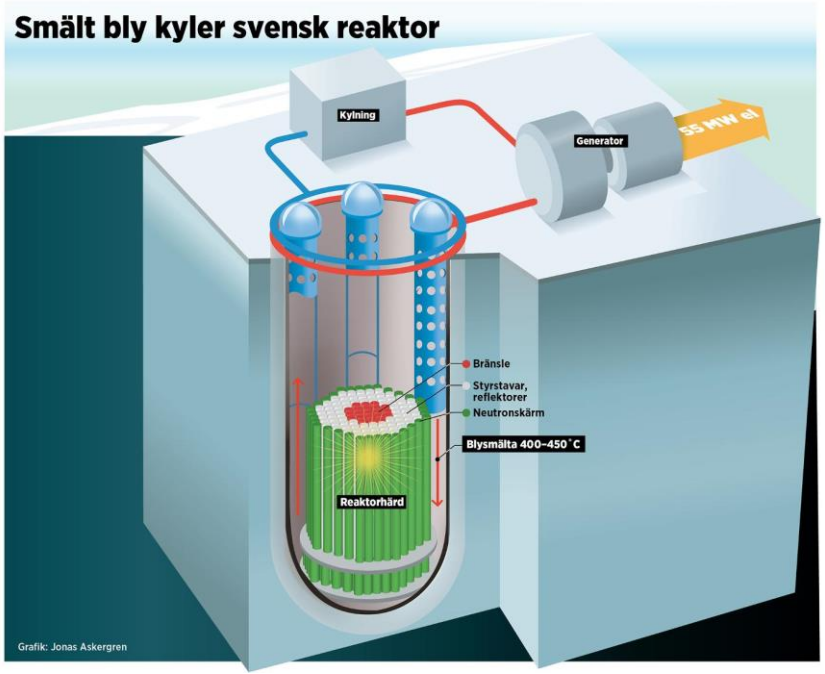
LEAD COOLED NUCLEAR REACTORS

- Molten lead a viable option for nuclear
- But *very* corrosive to most alloys
- Kanthals work!



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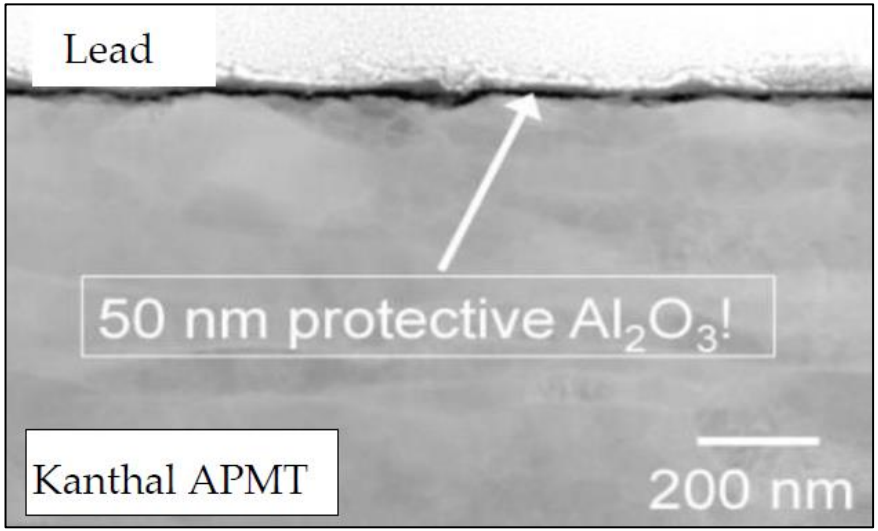
KANTHALS – RESISTANT TO MOLTEN LEAD

550 °C, 10 000 H



- Thin aluminium oxide
- Metal underneath unaffected
- Similar to stainless steel in water

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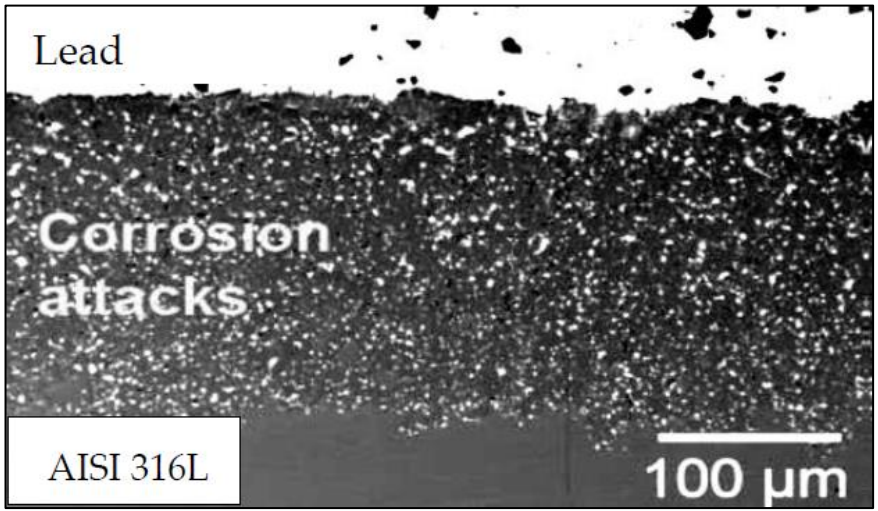
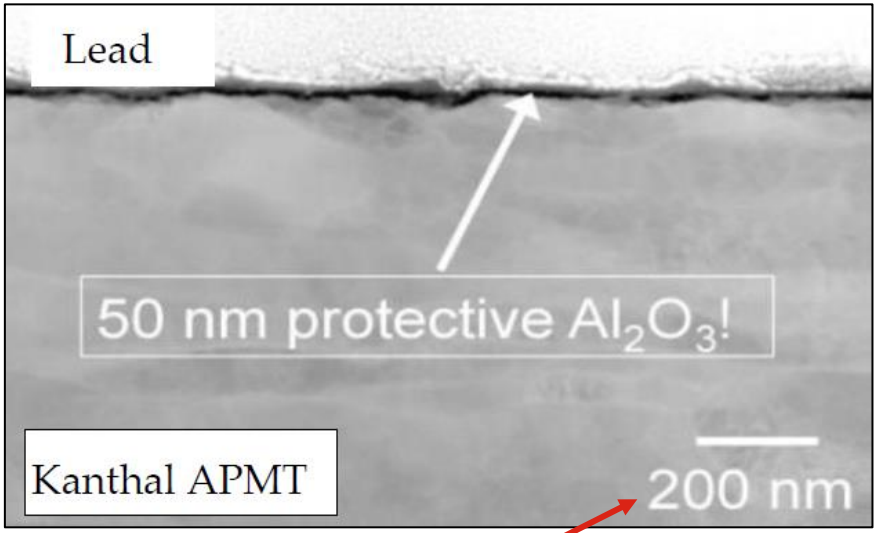
KANTHALS – RESISTANT

550 °C, 10 000 H





Note the different magnifications!

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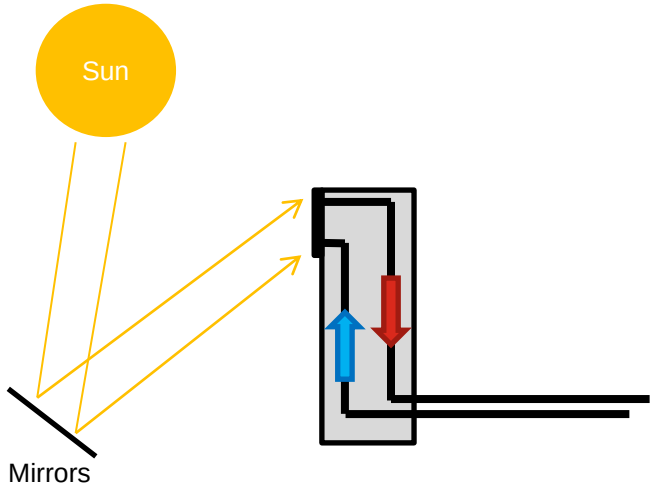
CONCENTRATED SOLAR POWER

- Intermittent power



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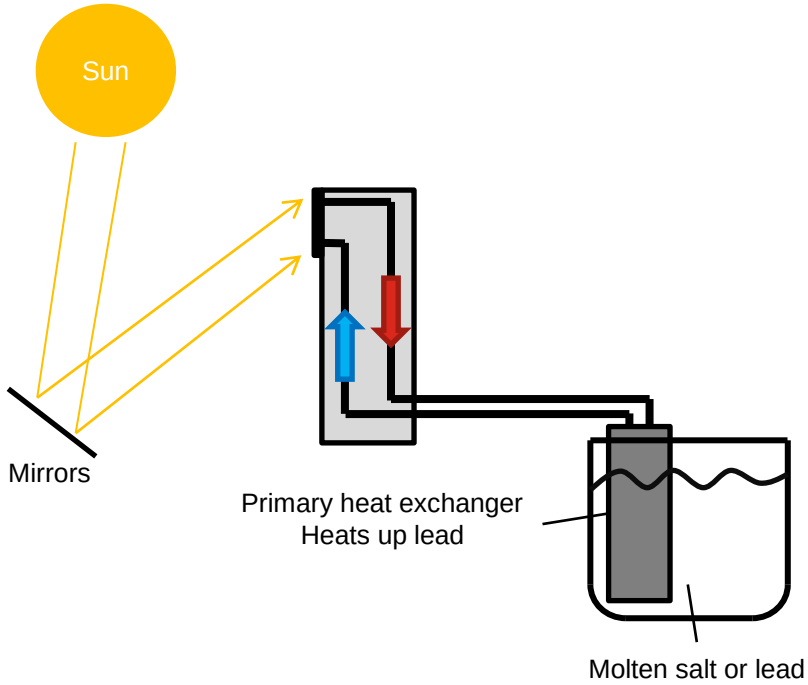
CONCENTRATED SOLAR POWER

- ~~Intermittent power~~
- Thermal energy storage
  - Molten salt
  - Molten lead



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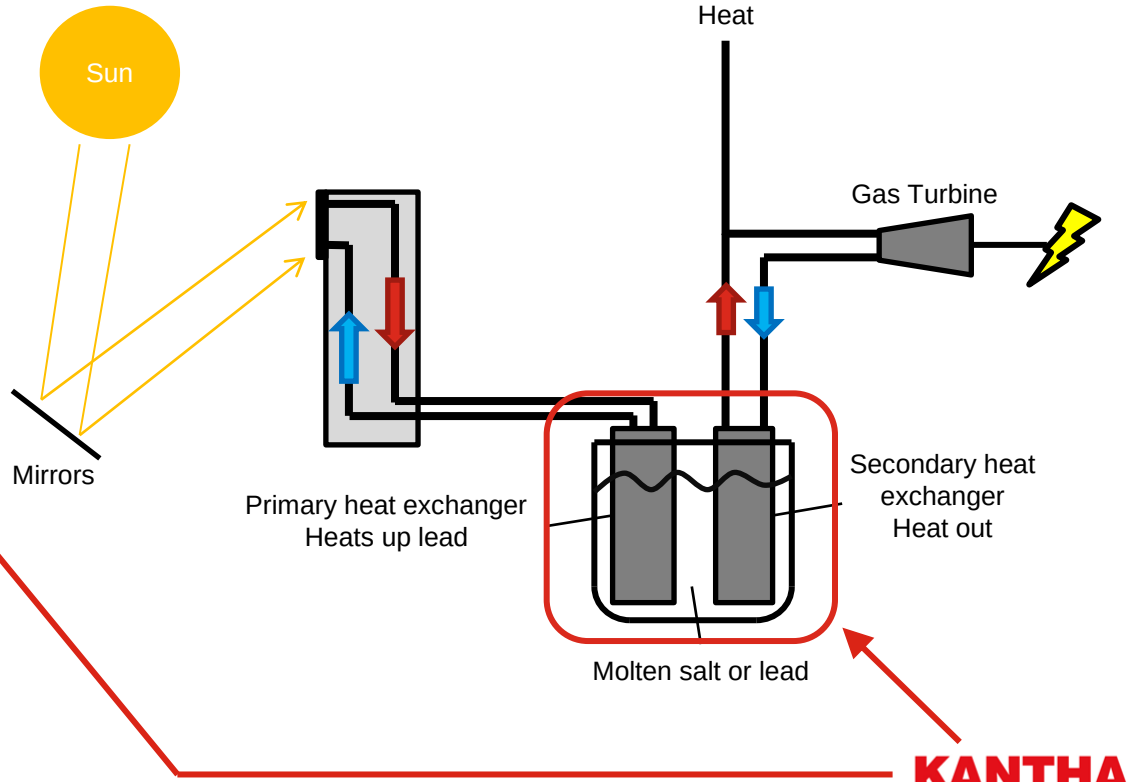
CONCENTRATED SOLAR POWER

- ~~Intermittent power~~
- Thermal energy storage
  - Molten salt
  - Molten lead
- On demand power
  - Electricity
  - Industrial process heat



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WASTE/BIOMASS TO ENERGY

- Fuels
  - Wood chips/pellets
  - Recycled wood
  - Waste
- Heavily corrosive gases!
- Kanthals corrodes, but relatively slowly

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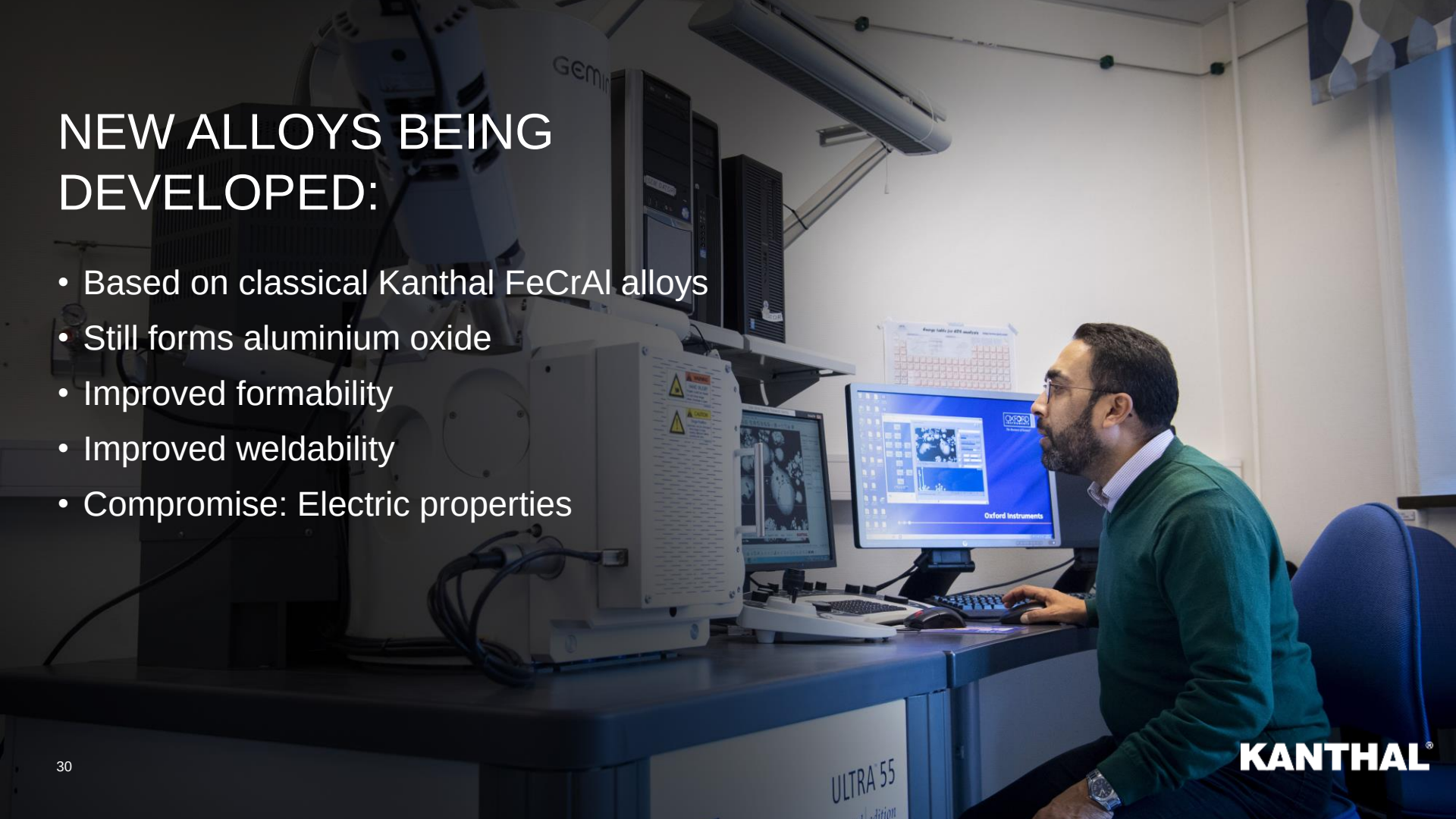
NEW ALLOYS BEING DEVELOPED:

- Based on classical Kanthal FeCrAl alloys
- Still forms aluminium oxide
- Improved formability
- Improved weldability
- Compromise: Electric properties



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SUMMARY

- Burning fossil fuels → Electric heating → Less CO_2
  - Bonuses:
  - Better quality and work environment
- Kanthals form aluminium oxide → Enable green technologies → Less CO_2
  - Highly protective
  - Resistant to molten lead and salt
  - Decent resistance against gases from burning waste/biomass

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