Contribution ID: **132** Type: **Oral Presentation**

All-Electric Plasma Torches as a Replacement for Industrial Gas Burners

Monday 11 May 2026 12:30 (20 minutes)

In the course of industrial decarbonization, the substitution of gas burners in industrial furnace systems is becoming increasingly important. All-electric plasma torches offer a viable alternative for retrofitting existing systems. These can be implemented without requiring a complete system overhaul.
Both electrode and electrodeless plasma systems are used. Electrodeless systems operate virtually wear-free and are therefore ideally suited for extended maintenance-free operation.
The system developed by XERION is based on plasma generation in an inductively coupled high-frequency electromagnetic field. This incorporates XERION's extensive experience in high-temperature furnace construction and its comprehensive expertise in inductive heating processes.
Results and experiences from a 65 kW experimental unit, built in-house and operated under variable conditions for several months, are reported. Part of the experimental unit is a gas-tight chamber directly flanged to the plasma torch. This allows for excellent analysis of the heat transfer from the torch to a furnace chamber. The behavior under various plasma gases and furnace atmospheres, such as argon, air, and hydrogen, is also tested. The use of hydrogen as the plasma gas is of particular interest because the reducing effect is significantly increased by ionization.
Key factors for the industrial application of these plasma torches are the achievable efficiency and the necessary long-term stability.
Furthermore, a 150 kW XERION plasma system is described, which will be operated on a rotary kiln as part of an international research project.
The outlook presents the possibilities for increasing the power output up to the megawatt range and the combination with various industrial furnaces. The use of novel silicon carbide-based power electronics components enables the cost-effective implementation of high-voltage, high-frequency circuits required to power the inductors.
The future application as direct firing of rotary kilns in the temperature range above 1,100℃ appears particularly promising.
These all-electric plasma torches can also be used as a replacement for auxiliary burners, such as those used in Electric Arc Furnaces. This allows such systems to be operated 100% electrically, eliminating the need for natural gas.

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Session Classification: Ongoing Research in Electric Steelmaking I

Track Classification: EEC 6 - Research and Development: EEC 6.C Future directions and emerging technologies in the field