In-situ apparatus connected to XPS for gas-metal reactions and wettability studies at high temperatures

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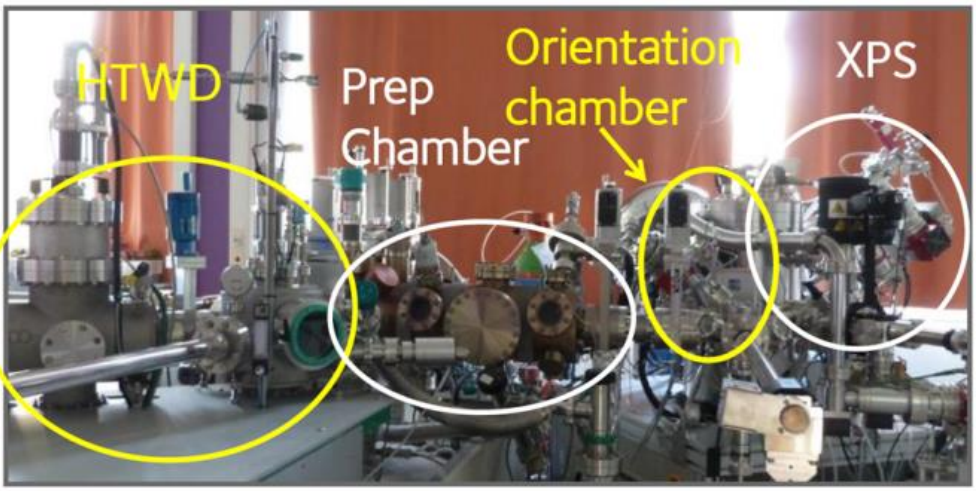
The understanding of gas–metal reactions and related surface wettability at high temperatures is often limited due to the lack of in-situ surface characterization. Ex-situ transfers at low temperature between annealing furnace, wettability device, and analytical tools induce noticeable changes of surface composition distinct from the reality of the phenomena. Therefore, a high temperature wettability device was designed in order to allow in-situ sample surface characterization by X-rays photoelectron spectroscopy after gas/metal and liquid metal/solid metal surface reactions. Such airless characterization rules out any contamination and oxidation of surfaces and reveals their real composition after heat treatment and chemical reaction.

The device consists of two connected reactors, respectively, dedicated to annealing treatments and wettability measurements. Heat treatments are performed in an infrared lamp furnace in a well-controlled atmosphere conditions designed to reproduce gas–metal reactions occurring during the industrial recrystallization annealing of steels. Wetting experiments are carried out in dispensed drop configuration with the precise control of the deposited droplets kinetic energies. The spreading of drops is followed by a high-speed CCD video camera at 500-2000 frames/s in order to reach information at very low contact time.

First trials have started to simulate phenomena occurring during recrystallization annealing and hot-dip galvanizing on polished pure Fe and FeAl8 wt.% samples. The results demonstrate real surface chemistry of steel samples after annealing when they are put in contact with liquid zinc alloy bath during hot-dip galvanizing. The wetting results are compared to literature data and coupled with the characterization of interfacial layers by FEG-Auger. It is fair to conclude that the results show the real interest of such in-situ experimental setup for interfacial chemistry studies.



General view of the transfer path from to High Temperature Wetting Device (HTWD) to XPS