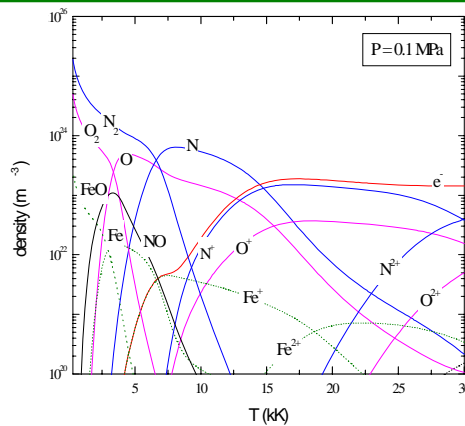


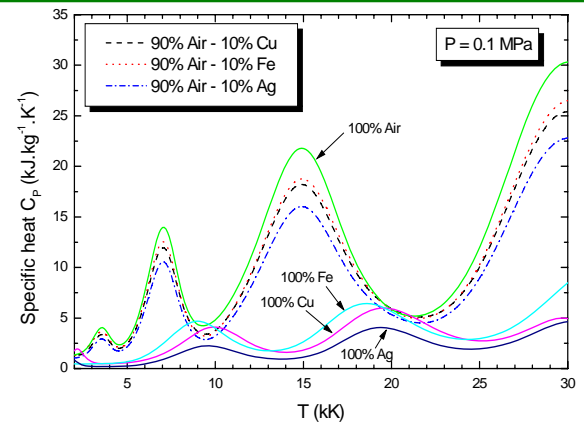
Influence of metallic vapours on air thermal plasmas properties

An electric arc inside a low voltage circuit breaker is burning in air and metallic vapours such as copper, iron or silver proceeding from the ablation of contacts, rails and splitting plates. The presence of metals modifies the properties of thermal plasmas. This work presents the radiative and transport properties for Air-Fe, Air-Cu and Air-Ag thermal plasmas; all the proportions are molar. The temperature range for the equilibrium composition lies between 300K and 30000K assuming only gaseous phase. At low temperature, metals or their components are mainly in solid form and all the results other than the composition will be presented in the temperature range between 2000 and 30000 K.

We have taken into account 27 different species, i.e., e^- , O, O^+ , O^{++} , O^{+++} , O^- , N, N^+ , N^{++} , N^{+++} , O_2 , O_2^+ , O_2^- , N_2 , N_2^+ , NO, NO_3 , N_2O_3 , N_2O_4 , N_2O_5 for the Air plasma and Ag, Ag^+ , Ag^{++} , Ag^{+++} , Ag^- , Ag_2 , AgO or Fe, Fe^+ , Fe^{++} , Fe^{+++} , Fe^- , Fe_2 , FeO or Cu, Cu^+ , Cu^{++} , Cu^{+++} , Cu^- , Cu_2 , CuO species due to the presence of metallic vapours.



Composition 99%air-1%iron



Specific Heat at constant pressure

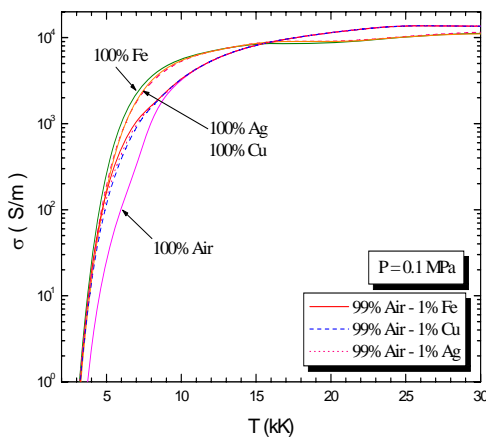
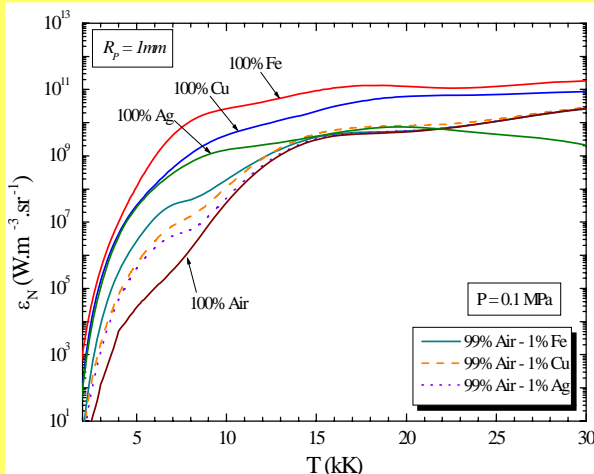
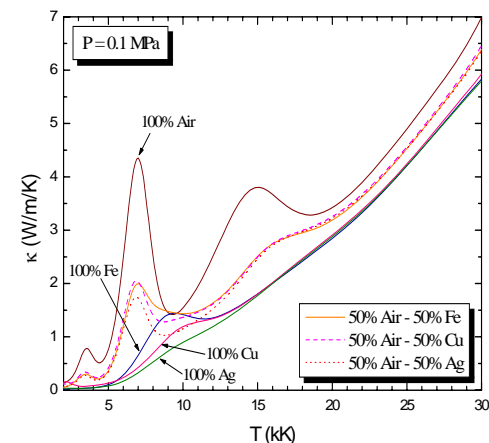


Figure on the left shows the electrical conductivity for pure plasmas and for mixtures containing 1% of metallic vapours. This figure highlights the influence of the metal vapours on the electrical conductivity due to a lower ionization potential for Fe, Cu and Ag than that of oxygen and nitrogen neutral species. The influence of metal is not so important on the thermal conductivity as it can be seen in figure on the right.



A small concentration of metallic vapours (1% here) tends to strongly increase the radiation of the plasma for temperatures ranging from 5000K to 12000K. This effect is due to the high emissivity of metallic vapours illustrated in the figure by the curves for pure metals. Two kinds of phenomena may explain this behaviour: the ionisation energy for the metals is lower than those of nitrogen or oxygen, leading to high values of the electron number density at low and intermediate temperatures; the metallic lines are less absorbed than the OI and NI lines. This last effect is particularly enhanced in the case of iron, this metal having a rich spectrum composed of a very big number of lines and these lines have a major contribution on the NEC.