THE ROLE OF HYDRATION WATER IN ISOTHERMAL STEP ANNEALING OF NEUTRON IRRADIATED SODIUM NITROPRUSSIDE

C. Di Risio, R.O. Marqués

Departamento de Química Inorgánica,
Analítica y Química Física,
Facultad de Ciencias Exactas y Naturales,
Universidad de Buenos Aires,
Buenos Aires, Argentina

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A kinetic study of isothermal step annealing of neutron-irradiated sodium nitroprusside has been performed. The influence of water and γ-irradiation on the behaviour of the compound is analyzed and compared with previous results obtained with the analogous compound Na₂/Fe/CN/₅NO/.2H₂O. It is possible to characterize two different fundamental processes that, in spite of occurring at two different temperatures, present the same activation energy than the hydrated system.

INTRODUCTION

In a previous paper we have reported on the punctual defect annealing, generated by /n,γ/ reaction on sodium nitroprusside. This work completes the previous one, and emphasizes the importance of crystal lattice in the study of the behaviour of the system.
According to interstitial atoms formation model of Szilard-Chalmers process, annealing implies defect migration through the lattice, to regenerate the original species.

Thermodynamically, this process is characterized by a free enthalpy, $\Delta G^M; \Delta G^M = \Delta H^M - T \cdot \Delta S^M$, where $\Delta H^M$ and $\Delta S^M$ are the migration enthalpy and migration entropy, respectively. $\Delta G^M$ is the energy barrier, which is necessary to overcome to produce defects movement in the lattice, and it depends on the atomic arrangement.

In damage caused by nuclear recoil /neutron capture reactions/, it is possible to find different processes which contribute to regenerate the original species, and can be characterized by the involved energies. It is suggested that the presence of hydration water affects the neutron irradiated sample annealing process but from the point of view of the presence of oxygen and not from the lattice changes.

We compared the behaviour of hydrated and dehydrated Na$_2$Fe(CN)$_5$NO/.

EXPERIMENTAL

Sodium nitroprusside of p.a. Merck grade was used throughout the experiments. It was dehydrated according to thermogravimetric analysis. These analyses also insure that the non-irradiated material is stable at the tested temperatures.

Thermal annealing was carried out in an air oven /temperature precision $\pm$0.5 °C/.

Samples were irradiated for 12 h in the RA-3 reactor /CNEA-CAE/: neutron flow = 1.5/2.0x10$^{13}$ cm$^{-2}$s$^{-1}$; irradiation temperature = 60 °C; $\gamma$-dose $\approx$ 20 MRad h$^{-1}$. 