Positron Parameters for Atypical Samples (Rocks & Powdered Catalysts)

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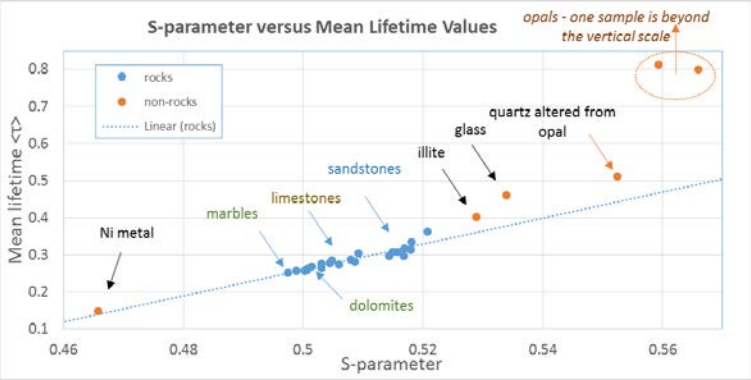
Rocks, minerals and scarce amounts of powdered catalysts, not considered "typical" PAS materials were included in our studies. This work was done to find an appropriate method to characterize atypical materials in a unique way by proper set of parameters in a well-defined environment. The PAS analysis results were compared with other supplementary techniques including XRF, EDX, SEM, RGAS and BET analysis to understand the results better.

Although rocks are heterogeneous mineral aggregates, some PAS values were distinctly different for dry sandstones, limestone and dolomites. The mean lifetime and Doppler curve shape depended on rocks' conditions: dry, in brine or water; or state: solid or a powder. The PAS of rocks heated up to 200^0 C revealed that the conventional S versus W-parameter ranges need to be modified to include the intermediate momentum range which was called SW-parameter. This was explained by a presence of different character of bonds, ionic and covalent, rather than metallic for which the division into S and W was defined to separate annihilation events due to free conducting electrons, or tightly bound core electrons. In summary, every rock/condition can be characterized uniquely by a unique set of mean lifetime and extended DBS values [1].



Additionally, opals in different stage of diagenesis and crystallization [2], and pure metals were examined. Fig.1 shows the relationship of S-parameter versus mean lifetime values. Different rock types are grouped tightly along the diagonal. The deviation of linearity is attributed to the intensity of Ps formation in some non-rocks.

Figure 1 *S-parameter versus Mean Lifetime Values for Rocks versus non-Rocks*

In contrast to rocks, catalyst zeolite powders represent another class of porous minerals. The obstacle that we encountered came from the fact that the samples were of low density and mass, usually less than 0.1 g, obtained from batches of fresh or processed through chemical reactors. We had to build special well-characterized sample holders to encapsulate the powder in thin Kapton film to prevent the potential contamination of the radioactive source and to optimize the geometry for enhancing positron annihilation event with the catalyst. We also used a sophisticated data analysis program for positron range analysis, LYS-1 [3], to determine the fraction of positron annihilating in the powder as compared to the source, Kapton envelope and backing [4]. When we used a well-controlled environment, and took into account matrix effects, the preliminary results of catalysts' PAS analysis became quite promising.

References

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