The chemical composition of IRAS 05341+0852: a post-AGB F supergiant with 21 μm emission

B.E. Reddy[1], **M. Parthasarathy**[1,2], **G. Gonzalez**[3] **and E.J. Bakker**[4]

[1]Indian Institute of Astrophysics, Bangalore; [2]Observatoire Astronomique, Strasbourg;
[3,4]University of Texas, Austin

An abundance analysis of the photosphere of the F-type Post-AGB candidate IRAS 05341+0852 is presented. It shows that the star is metal-poor ([Fe/H]=−1.0) and carbon-rich (C/O≈2.2). Carbon, nitrogen, oxygen, silicon, and possibly lithium and aluminum are found to be over abundant. Most importantly this star has large overabundance of s-process elements which are as follows: [Y/Fe]= 1.80, [Ba/Fe]= 2.58, [La/Fe]= 2.86, [Ce/Fe]= 2.95, [Pr/Fe]= 2.27, [Nd/Fe]= 1.97, and [Sm/Fe]= 0.86. The overabundances of s-process elements and carbon in IRAS 05341+0852 is direct evidence for the association of s-process enhancements with shell-flashes and dredge-up. These are likely responsible for the increase in C/O. The possible overabundance of Li ([Li/Fe]$\leq$2.5) and Al ([Al/Fe]$\leq$ 1.1) in IRAS 05341+0852 could indicate that there was Hot Bottom Burning (HBB), where the base of the convective envelope is hot enough for nucleosynthesis to occur (Lattanzio 1993). HBB has been suggested as the mechanism responsible for the production of Li in the Li-rich AGB stars discovered by Smith and Lambert (1989). In fact these are bright AGB stars which are oxygen-rich rather than carbon-rich. Recent calculations by Sackmann and Boothroyd (1992) showed that Li-rich and O-rich AGB stars are the result of HBB. In the HBB models temperatures of the order of $0.5 - 1 \times 10^8$ K are encountered at the base of the convective envelope (Blöcker and Schönberner 1991). This is hot enough for the reaction ^{25}Mg(p,γ) ^{26}Al resulting in the production of Al.

The [S/Fe]=0.07 indicates that the low Fe abundance is intrinsic and is not due to fractionation. The low metallicity, heliocentric radial velocity ($v_r = 25$ km s^{-1}), and the high Galactic latitude ($b = -12^o$) indicate that this star belongs to an old disc population. The presence of circumstellar carbon molecular lines and C/O$\approx$ 2.2 sugget that the progenitor was a carbon star which has evolved to a carbon-rich post-AGB star.

Furthermore we have detected the C_2 Phillips and CN Red bands in absorption. We find rotational temperatures, column densities, and expansion velocities which show that these lines are formed in the detached circumstellar dust shell (the AGB ejecta) and we find an expansion velocity of the AGB ejecta of $v_{\rm exp} = 10.8 \pm 1.0$ km s^{-1}.

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