

SiO IN STAR FORMING REGIONS: BARNARD 1 AND ORION KL

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ABSTRACT Interferometric observations of the SiO ($J = 2 - 1$) line are carried out toward a low-mass-star forming region, B1, and a massive star forming region, Ori KL. Production mechanisms of SiO in these regions are discussed.

INTRODUCTION

SiO is the most fundamental Si containing interstellar molecule. This molecule has long been observed in the massive-star forming regions like Ori KL and NGC7538 and supernova remnant IC443 (e.g. Ziurys et al. 1989). Recently, Bachiller et al. (1990) detected the SiO ($J = 3 - 2$) line toward Barnard 1 (B1). Subsequently SiO has been detected in other low-mass-star forming regions, L1448 (Bachiller et al. 1991) and L1157 (Mikami et al. 1992). These results indicate that SiO is produced even in less-active star forming regions. In order to understand the formation processes of SiO in such regions, we studied a distribution of SiO in B1 with Nobeyama Millimeter Array (NMA) (Yamamoto et al. 1992). We also obtained the SiO distribution in Ori KL for comparison.

SiO IN BARNARD 1

Figure 1 shows the integrated intensity map of the SiO ($J = 2 - 1$) line toward B1. A synthesized beam is $8'' \times 10''$. Distribution of SiO consists of at least two compact clumps. The clump A is possibly apart from the *IRAS* source, although uncertainty of the *IRAS* position is large. The blue lobe of the CO ($J = 1 - 0$) outflow is distributed toward the south-west direction from the *IRAS* source (Nakayama 1988). However, a red-shifted wing component was not detected in their observations. In contrast, the red-shifted wing component is clearly seen in the SiO emission at the clump A. According to the H^{13}CO^+ observations, dense gas exists at the eastern side of the clump A. Therefore it is likely that the red lobe of the outflow collides with the dense gas, and, in such a shocked region, SiO is efficiently produced through evaporation of dust grains.

In L1157 the SiO emission arises from an interacting region between molecular outflow and dense gas. Furthermore the SiO emission is found in molecular bullets in the outflow of L1448. These facts along with our results on B1 suggest that interaction between outflow and dense gas plays a major role in the SiO production in low-mass-star forming regions.

SiO IN ORION KL

The distribution of SiO ($J = 2 - 1$) in Ori KL was first studied by Wright et al. (1983) with the Hat Creek interferometer. We obtained higher resolution ($3''$) map to investigate interaction between outflow and ambient gas. Figure 2 shows the distribution of the red-shifted component of SiO superposed on the H_2CO ($2_{11} - 2_{12}$) integrated intensity map (Mangum et al. 1990). The SiO emission

clearly traces the eastern edge of the H_2CO distribution, suggesting that the outflow is blowing up the ambient cloud. The SiO emission seems to represent shocked regions in interface between outflow and ambient gas.

The distribution of SiO in the central velocity range has an unresolved component associated with IRC2 (Wright et al. 1983; Yamamoto et al. 1993). This indicates that SiO is produced by radiation heating from IRC2. The high velocity component of SiO shown in Figure 2 may represent a part of outflowing SiO from IRC2. However, it seems possible that high velocity SiO is produced in the shocked region apart from IRC2 through the same mechanism as in the case of low-mass-star forming regions.

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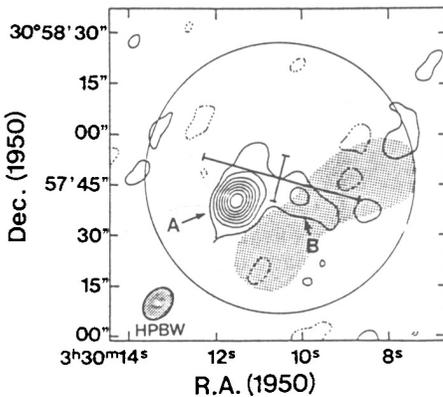


Figure 1: Integrated intensity map of SiO ($J = 2 - 1$). The shaded area represents the distribution of the CO blue lobe (Nakayama 1988).

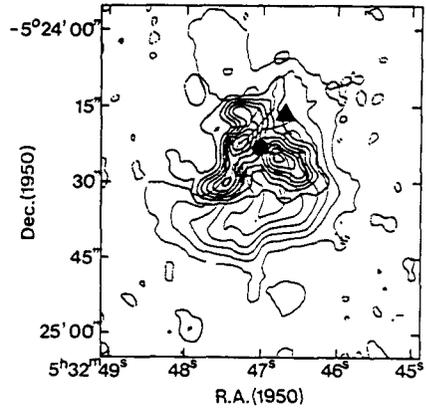


Figure 2: Map of the red-shifted component ($26 < v < 30 \text{ km s}^{-1}$) of SiO ($J = 2 - 1$) (thick contours) superposed on a total integrated intensity map of H_2CO (Mangum et al. 1990; thin contours).