

ISO–SWS spectra of [WR] planetary nebulae

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Abstract. We have analyzed Infrared Space Observatory Short Wavelength Spectrometer (ISO–SWS) observations for 16 Wolf–Rayet ([WR]) planetary nebulae (PNe) with the aim of identifying the dust features present in this group of objects. We have found that Polycyclic Aromatic Hydrocarbon (PAH) molecular bands (which are present in most of the observed [WR] PNe) are more frequent than crystalline silicate features.

1. Introduction

One of the most intriguing ISO results was discovery that coexistence of O–rich and C–rich material is much more common than previously believed. A mixed chemistry is somewhat surprising since formation of CO (one of the first stable molecules) is so efficient that less abundant element (C or O) is probably mostly used. Among sources with mixed chemistry there are (at least some) [WR] PNe. Recent ISO observations have shown that in this group of objects both forms of dust (C–rich: PAHs and O–rich: crystalline silicates) are present (Waters et al. 1998, Cohen et al. 1999). That [WR] planetary nebulae are *unusual* was known before ISO mission due to discovery of OH maser emission from one of this source (Vo 1) by Zijlstra et al. (1991) who already then discussed possibility that this star experienced in the recent past a dramatic change in its chemical composition from O– to C–rich. Presently, this scenario seems to be the most favourable. However, another scenario put forward by Cohen et al. (1999) to explain coexistence of C– and O–based features in [WR] planetary nebulae by means of destruction of the Kuiper belt (or Oort–cloud) like objects seems to be also possible. Note, that similar scenario has been proposed to explain the presence of water vapour in carbon–rich AGB star IRC+10216 (Melnick et al. 2001). Therefore, investigation of PAH and crystalline silicate features in [WR] PNe should give us some clues on their evolution and on the related chemical processes inside the expelled matter.

2. ISO–SWS spectra of [WR] PNe

In the ISO Data Archive there are 25 SWS spectra for 16 [WR] PNe from the list compiled by Górny (2001). As already discussed by Szczzerba et al. (2001) at least 75% of [WR] PNe have PAH features in their ISO–SWS spectra with K 2–16 being the only clear exception. Table 1 summarizes identified solid state features in [WR] PNe. The 33 μm feature is one of the resolved components of the broad 30 μm feature (Volk et al. 2002). It seems that crystalline silicates are less frequent than PAHs. Our preliminary results from modelling of these spectra showed that silicates should be cold while C–rich dust components should be relatively warm. In addition, dust emission from neutral parts of the envelopes seems to be necessary to explain far infrared part of the ISO data.

Table 1. Main solid state features in WR [PNe]

PN name	spectral type	UIBs	crystalline silicates	other features
He 3–1333	[WC 11]	+	+	
He 2–113	[WC 11]	+	+	
Vo 1	[WC 11]	+	+	
M 4–18	[WC 11]	+	?	
K 2–16	[WC 11]	–	–?	
SwSt 1	[WC 10]	+	–	33 μm ?
BD+30°3639	[WC 9]	+	+	
He 2–142	[WC 9]	+	+?	
He 2–459	[WC 9]	+	+?	
NGC 40	[WC 8]	+	–?	
M 2–43	[WC 7]	+	–	33 μm
Cn 1–5	[WC 7]	?	?	
NGC 6369	[WC 4]	+	–?	33 μm ?
NGC 5315	[WC 4]	+	+	
PM 1–89	[WC 4]	+	?	
NGC 5189	[WC 2]	?	?	

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