Wolf-Rayet Stars as a source of Pre-solar Grains

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Dust grains are the major constituents of baryonic matter distribution in the interstellar space as the refractory and moderately volatile elements get trapped in the dust grains. In the case of solar system, these dust grains are recorded in the meteorites, which are later separated and analyzed in the laboratory. These grains reflect the physicochemical processes that occurred in the early solar system. Isotopic measurements on meteorites show the isotopic heterogeneity of the solar nebula that is caused by pre-solar grains. Pre-solar grains are believed to have produced in stellar outflow as well as novae and supernovae ejecta. The grains which found their way to solar nebula and survived the solar system formation are reflected as the isotopic anomalies found in meteorites. It is widely seen that AGB stars and SNe are the potential sources of these anomalies (see e.g. [1,2]). However, we cannot rule out the Wolf-Rayet stars as the possible candidate for introducing dust particles in the solar system [3,4]. There are several pieces of observational evidences that the dust condensation takes place even in the harsh environments of WR stars [5,6]. We have developed a novel numerical code to perform the detailed thermodynamical equilibrium as well as non-equilibrium condensation calculations for the WN and WC phases of non-rotating as well as rotating stellar models [7].

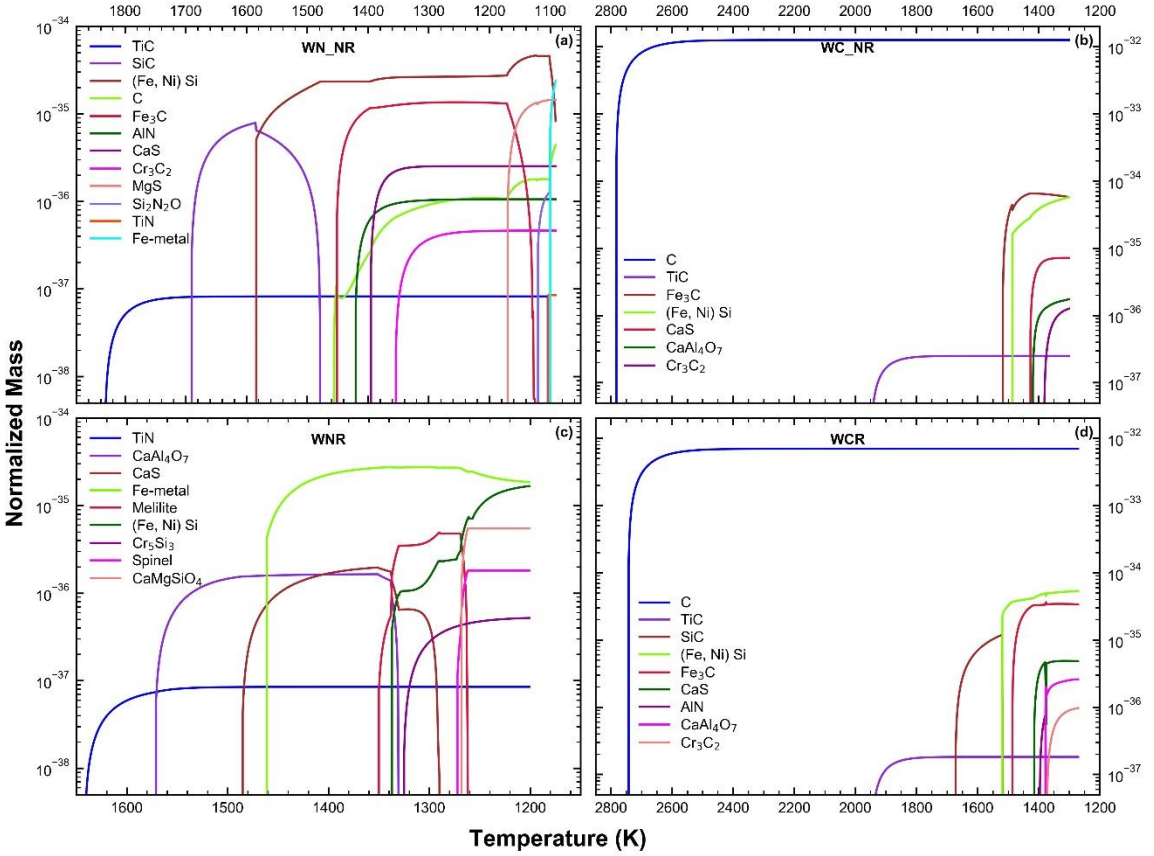

Figure1. The normalized mass distribution of the condensed phases as a function of temperature for a) WN composition in a non-rotating stellar model, b) WC composition in a non-rotating stellar model, c) WN composition in a rotating stellar model, d) WC composition in a rotating stellar model, at a pressure of 10^{-3} bar.

Distinct grains condensed in considered astrophysical environments are presented in Figure 1. The diverse environments and the associated physicochemical processes provide a wide-range of possible mineralogical sequences with grains of different chemical and isotopic compositions. We found that WR stars can be the sources of graphite and carbide grains present in the solar system. WN stars have comparatively high value of ^{13}C isotope, whereas, WC stars are almost completely ^{13}C depleted. Moreover, WR stellar winds can also be a source of the oxide grains. The grains extremely depleted in ^{18}O isotope can be associated with non-rotating WN and WC stars. Rotating WN stellar models produces grains that are depleted in ^{16}O isotope.

References:

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