

TOPICAL REVIEW

Variety of valence bond states formed of frustrated spins on triangular lattices based on a two-level system Pd(dmit)₂Masafumi Tamura *et al* 2009 *Sci. Technol. Adv. Mater.* **10** 024304 (12pp) doi: [10.1088/1468-6996/10/2/024304](https://doi.org/10.1088/1468-6996/10/2/024304) [Help](#)[Full text](#) | [PDF \(827 KB\)](#) | [References](#)[Masafumi Tamura](#)¹ and [Reizo Kato](#)²¹ Department of Physics, Faculty of Science and Technology, Tokyo University of Science, Noda, Chiba 278-8510, Japan² Condensed Molecular Materials Laboratory, RIKEN, Wako, Saitama 351-0198, Japan
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Abstract. Recent studies on the physical properties of the triangular system based on the Pd(dmit)₂ salts (dmit=1,3-dithiole-2-thione-4,5-dithiolate) are reviewed. Quantum chemical architectures of the Pd(dmit)₂ molecule and its dimer are introduced with emphasis on the strong dimerization of a two-level system, which provides unique physical properties of the salts. The magnetic properties are outlined in view of the magneto-structural correlation specific to the frustrated spin systems. Some newly discovered ground states and their origins are discussed, for which the valence bond formation plays a key role. Among them, the two-level structure is crucial for the novel charge-separated state found in two salts. The valence bond ordering, similar to the spin-Peierls transition, has been found in a two-dimensional frustrated spin system. The physical aspects and possible relation to the pressure-induced superconductivity are discussed.

Keywords: Pd(dmit)₂ salts, triangular lattice, antiferromagnets, frustration, HOMO-LUMO interplay, spin gap, superconductivity

Print publication: Issue 2 (April 2009)

Received 18 October 2008, accepted for publication 4 November 2008

Published 6 July 2009

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