Vortices lattices and spin textures in a rapidly-quenched rotating spinor Bose-Einstein condensate of [sup]23[/sup]Na

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By solving the stochastic projected Gross-Pitaevskii (GP) equation, we investigate the dynamics of an F=1 spinor Bose-Einstein condensate (BEC) of ^{23}Na during the rotating evaporative cooling. We find that, during the quench, the condensates described by the order parameter Ψ=(Ψ_1,Ψ_0, Ψ_{-1}) grow up but in the meantime, quantized vortices nucleate in all three components of the spinor BEC. When the rotating cloud reaches equilibrium at very low temperatures, vortices of each component would closely bind up in pairs and then arrange themselves into some particular spatial structures rather than the conventional triangular Abrikosov lattice. Considering each tightly bound vortex pair as a single entity, and connecting the center-of-mass locations of these pairs, we then find that the vortex pairs in each Ψ_i form a square lattice as a response to the external rotation. Additionally, the corresponding local spin texture S=(S_x,S_y,S_z) of the spinor BEC are studied. Our numerical calculations indicate that the spin textures of the condensates lead to the formation of regular array of magnetic domains at very low temperatures. Interestingly, we find that the magnetic moments of the neighboring domains are anti-parallel to each other that is similar to the Neel order of the magnetic moments in the anti-ferromagnetic materials.