# بسم الله الرحمن الرحيم


MONA MAGHRABY


# شبكة المعلومات الجامعية

# التوثيق الالكتروني والميكروفيلم

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شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

# جامعة عين شمس

# التوثيق الإلكتروني والميكروفيلم

# قسم

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Department: Geology

# Mineralogical and geochemical suitability of some Egyptian raw materials for the production of magnesio-aluminosilicate ceramics

A Thesis submitted for the degree of Doctor of Philosophy in Science in Geology

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# *Abstract*

This thesis focuses on studying the different types of talc rocks in the Central and Southern Eastern Desert to use it in the synthesis of cordierite-based ceramics. Ten locations with different varieties of talc rocks are chosen to achieve the goal of the study. These areas are Wadi Abu Fannani, Wadi Mubarak, Gabal Hijllij, Gabal Um Salatit, Wadi Barramiya, Gabal Mudargag, Wadi Antr, Wadi Nukharia and Wadi Allaqi. To differentiate between the ten talc ophiolitic types, petrological and geochemical studies were used.

The petrographic and geochemical studies showed that the talc rocks comprise talc, tremolite, serpentine, chlorite, quartz and carbonate. The samples of Wadi Allaqi and Wadi Antr are pure talc rocks. While the rocks collected from Wadi Mubarak are talc-tremolite rocks and Wadi Nukharia are talc-carbonate rocks. The studied talc rocks were created by hydrothermal solution effect on the ultramafic-mafic rocks whereas these rocks exhibit komatiitic trend.

Our purpose is to use the talc rocks in the dielectric ceramic materials. In order to attain this, nine batch compositions were prepared based on cordierite composition. The raw material and the fired samples are characterized using X-ray powder diffraction (XRD), X-ray fluorescence (XRF), thermal analysis (TGA) and SEM microscopy attached with energy dispersive X-ray analysis (EDAX).

The results revealed that the cordierite starts crystallization at 1200 ºC and continuous to increase at expense of cristobalite, enstatite, diopside, mullite and Mg-Al spinel with increasing sintering temperature. These samples show massive, subhedral, and holohedral well-developed cordierite crystals between 1200-1350 ºC. The physical features illustrate increasing trend of

average density up to 1200 ºC due to presence of high densities phases (enstatite, mullite and Mg-Al spinel) and filling the liquid phases into pores. However, increasing cordierite ratio cause to decrease of average bulk density with rising of sintering temperature.

The dielectric properties of sintered ceramic samples have been investigated over a wide frequency range ($10^{-1}$-$10^{6}$ Hz), using the broadband dielectric spectrometer (BDS). Antr and Allaqi ceramic samples have high permittivity and high loss tangent values. In contrast, these values considerably decreased for the ceramics of higher CaO content, i.e. ≥ 1.25 % (Nukharia and Salatit) due to hexagonal - orthorhombic phase in cordierite. Particularly, Nukharia showed much lower loss tangent values (0.0016) for all sintering temperatures. These features make Nukharia sintered samples promising in many applications, i.e. electrical capacitors, microwave devices, wireless communication, and etc. Variation of dielectric properties with sintering temperature was strongly dependent of ceramic composition. The dielectric properties found to be affected by DC conductivity and Maxwell Wagner Sillars (MWS) polarization at low frequencies.

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Key words: Ceramics; Talc; Cordierite; Permittivity; and Dielectric.

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