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Self Study Report (Cycle-3)

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Volume 28 (1) 2022, 11–25

Fundamental Solutions in the Theory of Micromorphic Thermoelastic Diffusion Materials with Microtemperatures and Microconcentrations

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Abstract:

The main purpose of this paper is to construct the fundamental solutions of a system of equations of isotropic micromorphic thermoelastic diffusion materials with microtemperatures and microconcentrations in case of steady oscillations in terms of elementary functions. In a particular case, the fundamental solutions of the system of equations of equilibrium theory of isotropic micromorphic thermoelastic diffusion materials with microtemperatures and microconcentrations are also established.

THEORETICAL AND APPLIED MECHANICS
Volume 49 (2022) Issue 1, 85–109 DOI: https://doi.org/10.2298/TAM211118007K

THE THEORY OF GENERALIZED MICROPOLAR THERMOELASTIC DIFFUSION WITH DOUBLE POROSITY

Tarun Kansal

Abstract. The main purpose of the paper is to derive the constitutive relations and field equations for anisotropic micropolar thermoelastic medium with mass diffusion and double porosity. In addition to this, the fundamental solution of system of equations in case of steady oscillations is also constructed.

1. Introduction

The classic theory of elasticity is not capable to represent the microstructure of various types of materials such as polycrystalline materials, materials with fibrous etc. The micropolar theory of elasticity takes into account the micro-structural motion of such types of materials. In this theory, the motion of solids are described by two vectors namely, displacement and microrotation. Eringen [1, 2] and Nowacki [3–5] included thermal effects in the theory to become micropolar theory of thermoelasticity. Boschi and Iesan [6] extended a generalized theory of micropolar thermoelasticity.

The transfer of mass of a substance from the high concentration regions to low concentration regions is called diffusion. Nowacki [7–10], Sherief et al. [11], Aouadi [12] and Kansal and Kumar [13] established the different theories of thermoelastic diffusion to describe the coupled mechanical behaviour among temperature, concentration, and strain fields in elastic solids. Aouadi [14] derived the theory of generalized micropolar thermoelastic diffusion based on the theory of Lord–Shulman with one relaxation time.

Biot [15] presented the first model for single porosity deformable solid by using the classical Darcy's law. The double porosity model represents a double porous structure, one is macro porosity which is connected to pores and other is micro porosity which is connected to fissures. The theory for deformable materials with double porosity was developed by Aifantis and co-workers [16–18]. Khalili and Selvadurai [19, 20] and Gelet et al. [21] established the basic governing homogeneous

2020 *Mathematics Subject Classification:* 74A15; 74A20; 74B05; 74E10; 74F05.

A study on radionuclides content and radon exhalation from soil of Northern India

Original Article | Published: 08 August 2019
Volume 78, article number 506, (2019) Cite this article

Vandana Devi, Amit Kumar & Rishi Pal Chauhan

Abstract

Radioactivity dispersed in indoor environment is a consequence of exhalation of radioactive gas radon from soil, building materials, and rocks containing primordial radionuclide. The health risk for population from the radionuclides and radon exhalation rates of soils from different places in vicinity of Kurukshetra in Northern India is estimated. Radionuclides content and radon exhalation rate of the soil samples are measured using gamma and alpha spectroscopy, respectively. Various doses (absorbed gamma dose and annual effective dose) and associated index (Alpha, Gamma, External, and Internal Radiation Hazard

Indian Journal of Pure & Applied Physics
Vol. 61, June 2023, pp. 416-422
DOI: 10.56042/ijpap.v61i6.2411

Assessment of Natural Radionuclides Content and Radon Exhalation of Clay Pulverized Fly Ash Bricks

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The bulk of bricks made worldwide are burnt clay bricks, and this volume of manufacture requires 230 - 242 million m^3 of agricultural land. This corresponds to 25,500 hectares of rich farmland at a depth of 1 meter. This type of exploitation will have a substantial detrimental impact on national food security. According to the present need, efficient use of industrial waste, such as fly ash, is necessary. So it becomes very important to limit the removal of top soil to build bricks and to encourage the use of pulverized fly ash (PFA) instead. So it is essential to examine the levels of radioactivity from natural sources and the amount at which radon is exhaled from building materials to manage the exposure of occupants to natural radiation. The radioactivity concentration of nuclides is determined using a high-resolution sodium iodide with a thallium activator gamma spectrometer. Radon exhalation rates were examined in the exhalation chamber using a hermetically shaped container and observing the activity over time. The focus of this research is to examine the radioactive concentration levels of radium, thorium, and potassium, as well as radon exhalation rates of Clay-Pulverized Fly Ash bricks mixed in different proportions. All radiation hazard factors linked with the radioactive nuclide and radon exhalation rates of clay pulverized fly ash bricks are examined and compared to the recommended limits from the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) data.

Keywords: NaI(Tl) scintillator; Fly ash; Radioactivity; Radon exhalation; Natural radiation exposure

1 Introduction

The study of radiation is essential for our everyday lives as it makes us aware of the harmful effects of naturally occurring radiation sources. In actuality, radioactivity may be found in our bodies, the soil we walk on, and the air we breathe. For environmental protection, radioactive material monitoring is crucial. It is important to use quick and precise radioactivity measurement techniques[1]. Radon and its progeny

billion bricks, utilizing approximately 440 million tonnes of soil. The bulk of bricks made worldwide are burnt clay bricks, and this volume of manufacture requires 230 - 242 million m^3 of agricultural land. This corresponds to 25,500 hectares of rich farmland at a depth of 1 meter. This type of exploitation will have a substantial detrimental impact on national food security[2]. On the other hand, fly ash is a waste product derived from thermal power plants using coal as fuel

Bidirectional Controlled Quantum Teleportation Using Eight-Qubit Quantum Channel in Noisy Environments

Published: 15 August 2020
Volume 59, pages 3156–3173, (2020) Cite this article

Moein Sarvaghad-Moghaddam, Zeinab Ramezani & I. S. Amiri

Abstract

In this work, a novel protocol is proposed for bidirectional controlled quantum teleportation (BCQT) in which a quantum channel is used with the eight-qubit entangled state. Using the protocol, two users can teleport an arbitrary entangled state and a pure two-qubit state (QBS) to each other simultaneously under the permission of a third party in the role of controller. This protocol is based on the controlled-not operation, appropriate single-qubit (SIQ) UOs, and SIQ measurements in the Z and X-basis. Also, in this paper, a new criterion of merit named as (predictability of the controller's qubit (QB) by the eavesdropper) is introduced, and the protocol is improved based on it. Then, the proposed protocol is investigated in two typical noisy channels, the amplitude-damping noise (ADN) and the phase-damping noise (PDN). The analysis of the protocol in the noisy

Compressibility Studies of Solvation Behaviour of Lithium and Sodium Ions in Nitromethane + Dimethylsulfoxide Binary Mixtures at 298.15 K

https://doi.org/10.14233/ajchem.2021.23388

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FTIR vibrational and ^{13}C NMR spectroscopic study of the effect on ionic transport behavior of $NaClO_4$ in *N*,*N*-dimethylacetamide and its binary mixtures with 2-aminoethanol

Original Paper | Published: 29 June 2023
Volume 29, pages 3143–3154, (2023) Cite this article

Suresh Kumar & Hardeep Anand

Abstract

This study explores the vibrational and nuclear magnetic resonance spectra of free ions as well as those coordinated with sodium ions, which are commonly utilized to study ion-ion and ion-solvent interactions in electrolytic solutions of dipolar aprotic solvents. The spectral investigations suggested the origin of new bands due to solvent shell of sodium ions. The ion-solvent interactions were confirmed by the carbonyl symmetric stretch ring deformation bands in *N*,*N*-dimethylacetamide. The probability of new contact ion pairs between sodium and perchlorate ions with N,N-dimethylacetamide (DMA) increases on enhancing the increase in electrolytic concentration of sodium perchlorate in binary solvent mixtures. FTIR vibrational spectra and ^{13}C-NMR spectra of several electrolytic concentration solutions of sodium perchlorate ($NaClO_4$) were studied in pure DMA and its binary mixture with 2-aminoethanol (AE). The study investigates the vibrational spectra

Arch. Mech., **70**, 3, pp. 241–268, Warszawa 2018
SEVENTY YEARS OF THE ARCHIVES OF MECHANICS

Generalized theory of thermoelastic diffusion with double porosity

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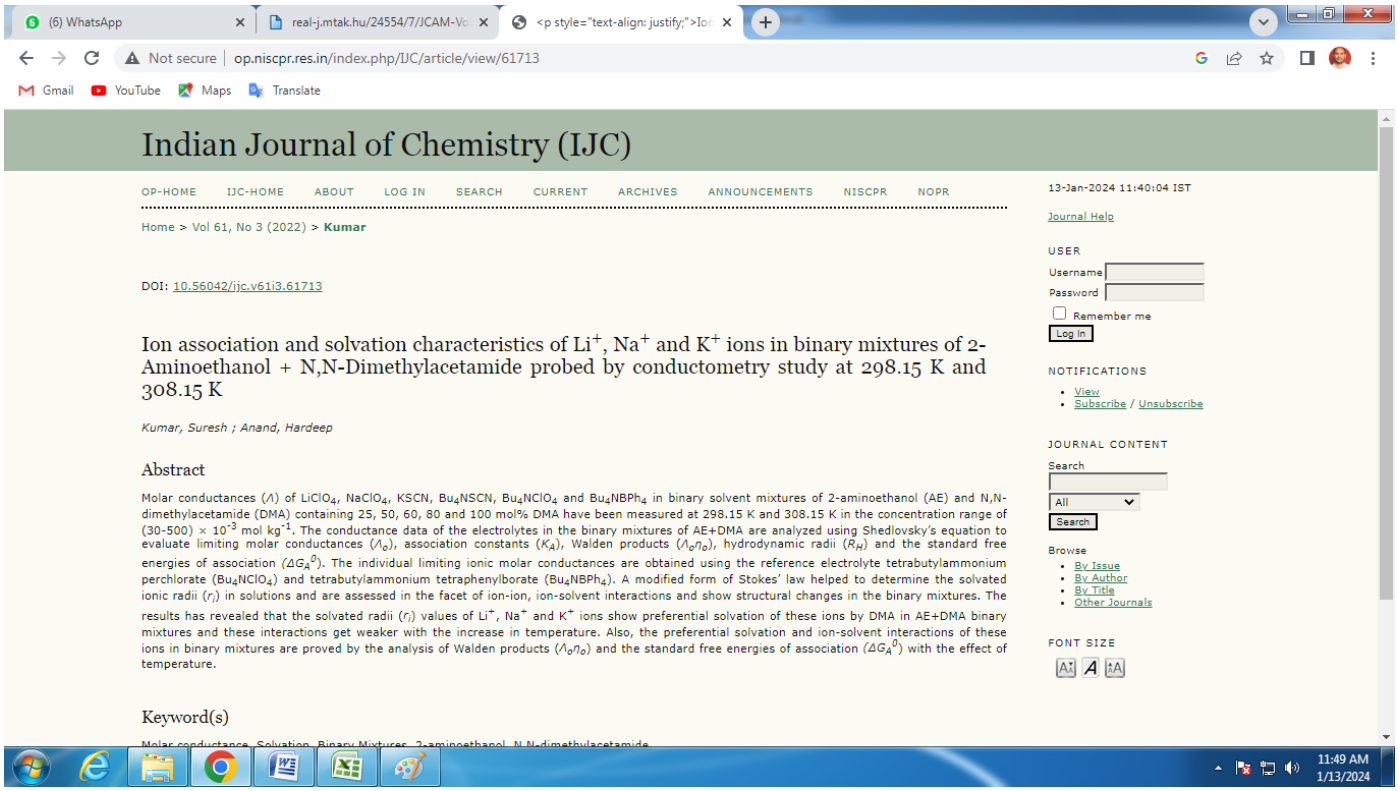
The present paper focuses on the derivation of the constitutive relations and field equations for anisotropic thermoelastic medium with mass diffusion and double porosity. The variational principle, uniqueness and reciprocity theorems are also derived.

Key words: thermoelastic diffusion, pores, fissures.

1. Introduction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By Author
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Home > Vol 61, No 3 (2022) > Kumar
DOI: 10.56042/ijc.v61i3.61713
Ion association and solvation characteristics of Li+, Na+ and K+ ions in binary mixtures of 2-Aminoethanol + N,N-Dimethylacetamide probed by conductometry study at 298.15 K and 308.15 K
Kumar, Suresh ; Anand, Hardeep
Abstract
Molar conductances (Λ) of LiClO4, NaClO4, KSCN, Bu4NSCN, Bu4NClO4 and Bu4NBPh4 in binary solvent mixtures of 2-aminoethanol (AE) and N,N-dimethylacetamide (DMA) containing 25, 50, 60, 80 and 100 mol% DMA have been measured at 298.15 K and 308.15 K in the concentration range of (30-500) × 10-3 mol kg-1. The conductance data of the electrolytes in the binary mixtures of AE+DMA are analyzed using Shedlovsky's equation to evaluate limiting molar conductances (Λo), association constants (KA), Walden products (Λoηo), hydrodynamic radii (RH) and the standard free energies of association (ΔGA0). The individual limiting ionic molar conductances are obtained using the reference electrolyte tetrabutylammonium perchlorate (Bu4NClO4) and tetrabutylammonium tetraphenylborate (Bu4NBPh4). A modified form of Stokes' law helped to determine the solvated ionic radii (ri) in solutions and are assessed in the facet of ion-ion, ion-solvent interactions and show structural changes in the binary mixtures. The results has revealed that the solvated radii (ri) values of Li+, Na+ and K+ ions show preferential solvation of these ions by DMA in AE+DMA binary mixtures and these interactions get weaker with the increase in temperature. Also, the preferential solvation and ion-solvent interactions of these ions in binary mixtures are proved by the analysis of Walden products (Λoηo) and the standard free energies of association (ΔGA0) with the effect of temperature.
Keyword(s)
Molar conductance, Solvation, Binary Mixtures, 2-aminoethanol, N,N-dimethylacetamide
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Journal of Computational and Applied Mechanics, Vol. 17, No. 2, (2022), pp. 85–104
DOI: 10.32973/jcam.2022.005

FUNDAMENTAL SOLUTIONS IN THE THEORY OF THERMOELASTIC DIFFUSIVE MATERIALS WITH MICROTEMPERATURES AND MICROCONCENTRATIONS

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[Received: September 22, 2022; Accepted: December 27, 2022]

Abstract. The main aim of this paper is to construct the fundamental solutions of a system of equations for isotropic thermoelastic diffusive materials with microtemperatures and microconcentrations in the case of steady oscillations in terms of elementary functions. In addition to this, the fundamental solutions of the system of equations of equilibrium theory of isotropic thermoelastic diffusivity materials with microtemperatures and microconcentrations are also established.

Mathematical Subject Classification: 74A15, 74A20, 74B05, 74E10, 74F05.
Keywords: Thermoelasticity, diffusivity, microtemperatures, microconcentrations

1. Introduction

Eringen and his co-workers [1–7] formulated the theories of micromorphic continua. In these theories, the particles of a continuous body are assumed to be composed of microelements which undergo homogeneous deformations called microdeformations. The system of differential equations and boundary conditions governing a continuum

Issue

Vol. 33 No. 6 (2021): Vol 33 Issue 6

Issue Published : June 5, 2021

Ion-Solvent Interactions Investigated by Isentropic Compressibility Measurements of Lithium and Sodium Salts in Binary Mixtures of Acetonitrile and Nitromethane at 298.15 K

https://doi.org/10.14233/ajchem.2021.23273

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Measurement of optimal thickness of radon-resistant materials for insulation using diffusion coefficient

Published: 27 November 2020
Volume 327, pages 425–431, (2021) Cite this article

Amit Kumar & R. P. Chauhan

Abstract

The uses of waterproofing materials for insulation including required optimal thickness are discussed in this work. There exists a difference of five orders of magnitude in the diffusion coefficient of building materials along with the four orders of magnitude in the thickness and diffusion length. The radon resistance offered by materials varies with (a) thickness for given diffusion coefficient and (b) with diffusion coefficient with same thickness to diffusion length ratio (d/L). The earlier assumption of using thickness equal to three times of diffusion length is not workable for all materials but it causes an underestimation or overestimation.

Minimum quantum noise and photon number statistics of a multimode radiation field in interaction with two 2-level atoms

Published: 13 March 2023
Volume 55, article number 417, (2023) Cite this article

Priyanka, Savita Gill & Jawahar Lal

Abstract

Higher order squeezing has been investigated in interaction of a multimode strong radiation field with an assembly of two 2-level atoms in various atomic states such as ground, super radiant and excited states. The variations of squeezing parameter for different atomic states closer to minima with coupling time for different photon numbers have also been discussed and shown graphically. Using Mandel's Q parameter, it has been found that all the atomic states show sub-Poissonian behavior.

Multidirectional Quantum Controlled Teleportation in Noisy Environment

RESEARCH | Published: 21 November 2023
Volume 62, article number 249, (2023) Cite this article

Simranjot Kaur, Priyanka, Jawahar Lal & Savita Gill

Abstract

The present paper aims to propose a theoretical novel protocol for implementing five-party Multidirectional Quantum Controlled Teleportation (MQCT) of a one-qubit state. Utilizing the entangled state of eleven-qubit as a quantum channel, one sender teleports to and receives different quantum information from distant three receivers simultaneously under the supervision of the fifth party as the controller. Hadamard gates, Controlled-Not (CNOT) gates and Controlled-Z gates (CZ) are used to construct the quantum channel. The proposed protocol is found to be more efficient as it has minimum resource consumption than most existing protocols. The protocol has been examined in noisy channels and the results show that the fidelities under Amplitude Damping Noise (ADN) and Phase Damping Noise (PDN) depend only upon the amplitude coefficients and the decoherence noisy rate. The proposed protocol has also been analyzed and found to be secure.

Indian Journal of Pure & Applied Physics
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DOI: 10.56042/ijpap.v61i6.2416

Multilayer Stack Method for Precise Measurement of Radon Diffusion Coefficient of Different Materials

Amit Kumar[a,*], Rajat Parkash[b], Ajay Garg[c], Nisha Mann[d], Jawahar Lal[a] & R P Chauhan[b]

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Radon-resistant materials are of great importance for High Background Radiation Areas. Depending on the radon diffusion coefficient, waterproofing and radon-resistant materials with thicknesses ranging from a few microns to several centimeters are used in various parts of the world. The cost of installation of an effective radon mitigation system varied with material properties, *i.e.*, thickness and diffusion coefficient. The present study is concerned with the measurement of the radon diffusion coefficient through single and multilayer homogeneous and heterogeneous stacks of various waterproofing materials. One, two, and three layers of polyethylene, printing paper, mica sheets, PVC sheets, Mylar sheets and aluminum foil of varying thicknesses are tested for determination of diffusion length by the two-chamber method and the active scintillation radon monitor. The radon diffusion coefficient of materials varies from 10^{-13}m^2/s to 10^{-8}m^2/s for PVC sheet to paper sheet when a single layer is used and 10^{-11} m^2/s to 10^{-13} m^2/s for aluminum and polyethylene sheets in multi-layer stack arrangement. The radon diffusion coefficient for most of the materials reduces with increasing layers in the stack. By the use of these materials, 85-90 % of radon can be reduced by using single or multi-layer stack combination.

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Preparation, Characterization and Properties of some Acrylic Base Latex: A Review

Volume 37, Number 5

Satish Kumar[1*], Shayoraj[1], Neeru Devi[1], Santosh Kumar Dubey[1], Ashwani Kumar[2], Suresh Kumar[3] and Kapil Gulati[4]

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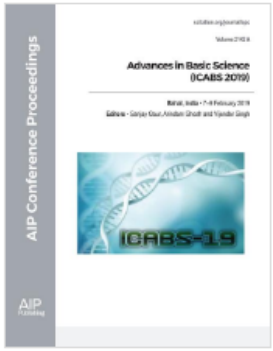
29 August 2019



ADVANCES IN BASIC SCIENCE (ICABS 2019)
7–9 February 2019
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RESEARCH ARTICLE | AUGUST 29 2019

Radiation doses due to background radioactivity in soil from inhabited area of Northern Haryana

Vandana Devi; Amit Kumar; R. P. Chauhan

AIP Conf. Proc. 2142, 120010 (2019)
https://doi.org/10.1063/1.5122506

All the earth crust materials contains radionuclides in varying amount according to geological and environmental conditions which results into external and internal radiation exposure. In addition to building materials soil is also used in construction and hence has fundamental importance in the estimation of radionuclides for human health safety. In this study, natural radioactivity concentrations of ^{226}Ra, ^{232}Th, and ^{40}K are investigated using the gamma spectrometer NaI (Tl) detector coupled with 1K MCA card. Activity concentration of radium, thorium and potassium vary from 40.91 to 67.59 Bq/Kg,106.7 to 199.33 Bq/Kg and 698.89 to 1996.62 Bq/Kg with an average of 50.76 ± 1.88 Bq/Kg, 154.69 ± 5.76 Bq/Kg and 1092.51 ± 112.58 Bq/Kg respectively. In addition, different radiological parameters and hazard indices were calculated from measured gamma ray activities associated with use of these materials. The results in the present study were compared with the world average and also with the reported data available in literature. Estimated radiological hazards are below the

THEORETICAL AND APPLIED MECHANICS
Volume 49 (2022) Issue 1, 85–109 DOI: https://doi.org/10.2298/TAM211118007K

THE THEORY OF GENERALIZED MICROPOLAR THERMOELASTIC DIFFUSION WITH DOUBLE POROSITY

Tarun Kansal

Abstract. The main purpose of the paper is to derive the constitutive relations and field equations for anisotropic micropolar thermoelastic medium with mass diffusion and double porosity. In addition to this, the fundamental solution of system of equations in case of steady oscillations is also constructed.

1. Introduction

The classic theory of elasticity is not capable to represent the microstructure of various types of materials such as polycrystalline materials, materials with fibrous etc. The micropolar theory of elasticity takes into account the micro-structural motion of such types of materials. In this theory, the motion of solids are described by two vectors namely, displacement and microrotation. Eringen [1,2] and Nowacki [3–5] included thermal effects in the theory to become micropolar theory of thermoelasticity. Boschi and Iesan [6] extended a generalized theory of micropolar thermoelasticity.

The transfer of mass of a substance from the high concentration regions to low concentration regions is called diffusion. Nowacki [7–10], Sherief et al. [11], Aouadi [12] and Kansal and Kumar [13] established the different theories of ther-

Variance and Mandel's Q parameter in para-squeezed states with squeezed parameter in a single mode electromagnetic field

Published: 18 December 2021

Volume 54, article number 56, (2022) Cite this article

Priyanka, Jawahar Lal & Savita Gill

Abstract

The present paper aims to investigates the generation of higher order low variance with the impact of squeezed parameter in para-squeezed states. It has been found that low variance in higher order occurs for specific ranges of squeezed parameter shown by graphical representation. Such states have also been found to have sub-Poissonian photon number statistics when evaluated using Mandel's Q parameter.

Issue

Vol. 33 No. 12 (2021): Vol 33 Issue 12

Issue Published : December 6, 2021

Viscometric Studies of Ion Solvation of Some Alkali Metal Salts in 2-Aminoethanol + N,N-Dimethylacetamide Binary Mixtures at 298.15 K and 308.15 K

https://doi.org/10.14233/ajchem.2021.23401

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