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ЭКОЛОГО-БИОЛОГИЧЕСКИЕ ОСОБЕННОСТИ НАКОПЛЕНИЯ ТЯЖЕЛЫХ МЕТАЛЛОВ В ЛИСТОВЫХ ПЛАСТИНКАХ ДРЕВЕСНЫХ РАСТЕНИЙ Г.АСТАНЫ

Анализ современного ассортимента древесных растений г.Астаны и лесного питомника АО «Астана Зеленстрой» свидетельствует о недостаточности видового разнообразия. Разделение растений по трем участкам позволит в дальнейшем провести полноценные сравнительные наблюдения за ростом и развитием интродуцентов.

Ключевые слова: тяжелые металлы, "кислотные дожди", санитарные нормы и правила.

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АСТАНА ҚАЛАСЫНЫҢ СҮРЕКТІ ӨСІМДІКТЕРІНІҢ ЖАПЫРАҚ ПЛАСТИНАЛАРЫНДА АУЫР МЕТАЛДАРДЫҢ ЖИНАҚТАЛУЫНЫҢ ЭКОЛОГИЯЛЫҚ-БИОЛОГИЯЛЫҚ ЕРЕКШЕЛІКТЕРІ

Астана қаласы «Жасыл құрылыс» АҚ орман тұқым бағында ағаш өсімдіктерінің қазіргі ассортиментін талдау барысында алуан түрліліктің жетіспеушілігі анықталынады. Өсімдіктерді 3 телімге бөлу арқылы интродуценттердің өсуі мен дамуын салыстырмалы бақылауға болашақта мүмкіндік береді.

Кілт сөздер: ауыр металдар, қышқылды жауын-шашын, санитарлық мөлшер және ережелер.

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SCANNING ELECTRON MICROSCOPY IN STUDIES OF BIOLOGICAL SAMPLES

Abstract. This article reviews methods of biological sample preparation including plant cell for scanning electron microscopy. The methods described below for SEM have proved satisfactory with a variety of different specimens and should with minor modification be suitable for most situations.

Keywords: scanning electron microscopy (SEM), transmission electron microscopy (TEM), biological sample preparation, plant cell, specimen and materials.

Introduction

The Kazakh-Japan Innovation Centre at the Kazakh National Agrarian University has installed a combination of light and electron microscopy devices to help researchers better understand the structure, function and capabilities of the plant, animal and microorganisms cell.

The centre’s Laboratory of Electron microscopy, established as part of the The Kazakh-Japan Innovation Centre, will complete assignments for KazNAU scientists and outside research groups as well as attempt to further the development of microscopic imaging. Three-dimensional mappings of cell internal structure as well as microscopic cell and tissue observation in living organisms are both capabilities of the laboratory.

Our goal is to provide the KazNAU research community with the highest quality microanalytical data. The laboratory's mission is to educate researchers and undergraduate, postgraduate students about the tools available to them and how best to utilize these resources to achieve their research and educational goals.

The Electron Microscopy Laboratory is a state-of-the-art facility on the KazNAU campus. The lab is open for use by students, faculty and staff of KazNAU, as well as regional commercial and non-profit groups with a need for the analytical services the lab can provide.

The Electron microscopes were purchased with funds provided by the state program of development of science of the Republic of Kazakhstan for 2007-2012 and installed in 2009.

Many fields of research have applications for SEM and TEM, including life science, earth science, materials science, medicine, pharmacy, environmental science, and engineering. Our microscopes are equipped with several detectors capable of surface imaging, compositional analysis, compositional imaging, and microtextural variability in a wide variety of materials at very high spatial resolutions.

The lab's microscopes allow researchers to observe changes in the cell of plants, animals and microorganisms in real time, helping the study of cell structure.

To achieve the best results during examination in the Electron Microscope (EM), the perfect EM Sample Preparation (for TEM, SEM) is a prerequisite. The required techniques depend on the samples (biological samples, material samples) as well as on the application. EM Sample Preparation incudes all methods of preparations from embedding, tissue processing, coating, immunogold labeling through ultrathin sectioning with ultramicrotomes, cryo-ultramicrotomy, cryosectioning, critical point drying, plunge freezing, freeze substitution, freeze fracturing, freeze drying, contrasting, cryofixation, high pressure freezing, cryo transfer, freeze etching, freeze fracture to ion beam milling, ion beam etching, and target preparation – mechanical ginding and polishing. Only if each step of sample preparation is of the highest quality, can optimum results be obtained from a high resolution electron microscope.

Two types of electron microscope have been used to study plant cells, the transmission (TEM) and scanning (SEM) electron microscopes. With the TEM, the electron beam penetrates thin slices of biological material and permits the study of internal features of cells and organelles. The TEM has been particularly important for basic studies of the structure and function of plant. Cell organelles such as microtubules and coated vesicles, examining polyethylene glycol-induced fusion of protoplasts, and monitoring internal changes during the development of cultured explains (e.g., Fowke 1989; Fowke et al. 1985, 1991). The electron beam of the SEM scans the surface ol prepared specimens. Thus, the SEM is important for studying the external morphology of intact cells, (tissues and organs and is capable of resolving details intermediate in size between those, detected by the light microscope and the TEM.

Specimen preparation for the TEM is much more complicated and time consuming than tor the SEM. Both procedures require specimen fixation and dehydration, but TEM specimens must also be infiltrated and embedded in epoxy resins, a process usually requiring a number of days. The ultramicrotome must also be mastered in order to prepare thin sections for examination in the TEM. Specimens fixed and embedded for TEM can also be sectioned and stained for light microscopy. Such sections facilitate location and orientation of critical specimens for observation in the TEM. In addition, the sections provide excellent material for morphological studies by tight microscopy.

Extensive and detailed methods for ultrastructural work with plants have been published in the form of reviews and books (e.g., Weakley 1981; Robinson et al. 1987; Hall and Hawes 1991), Methods vary with different specimens and, therefore, it is not possible to present a single standard method for all cultured plant materials. The methods described below for SEM have proved satisfactory with a variety of different specimens and should with minor modification be suitable for most situations.

Objectives and Goals

To provide detailed procedures for preparing plant materials for SEM analysis.

Equipment, Materials, and Reagents

All samples must also be of an appropriate size to fit in the specimen chamber and are generally mounted rigidly on a specimen holder called a specimen stub. Several models of SEM can examine any part of a 6-inch (15 cm) semiconductor wafer, and some can tilt an object of that size to 45°.

For conventional imaging in the SEM, specimens must be electrically conductive, at least at the surface, and electrically grounded to prevent the accumulation of electrostatic charge at the surface. Metal objects require little special preparation for SEM except for cleaning and mounting on a specimen stub. Nonconductive specimens tend to charge when scanned by the electron beam, and especially in secondary electron imaging mode, this causes scanning faults and other image artifacts. They are therefore usually coated with an ultrathin coating of electrically conducting material, deposited on the sample either by low-vacuum sputter coating or by high-vacuum evaporation. Conductive materials in current use for specimen coating include gold, gold/palladium alloy, platinum, osmium, iridium,tungsten, chromium, and graphite. Additionally, coating may increase signal/noise ratio for samples of low atomic number (Z). The improvement arises because secondary electron emission for high-Z materials is enhanced.

An alternative to coating for some biological samples is to increase the bulk conductivity of the material by impregnation with osmium using variants of the OTO staining method (O-osmium, T-thiocarbohydrazide, O-osmium).

Nonconducting specimens may be imaged uncoated using environmental SEM (ESEM) or low-voltage mode of SEM operation. Environmental SEM instruments place the specimen in a relatively high-pressure chamber where the working distance is short and the electron optical column is differentially pumped to keep vacuum adequately low at the electron gun. The high-pressure region around the sample in the ESEM neutralizes charge and provides an amplification of the secondary electron signal. Low-voltage SEM is typically conducted in an FEG-SEM because the field emission guns (FEG) is capable of producing high primary electron brightness and small spot size even at low accelerating potentials. Operating conditions to prevent charging of non-conductive specimens must be adjusted such that the incoming beam current was equal to sum of outcoming secondary and backscattered electrons currents. It usually occurs at accelerating voltages of 0.3–4 kV.

Embedding in a resin with further polishing to a mirror-like finish can be used for both biological and materials specimens when imaging in backscattered electrons or when doing quantitative X-ray microanalysis.

The main preparation techniques are not required in the environmental SEM outlined below, but some biological specimens can benefit from fixation.

Biological samples: For SEM, a specimen is normally required to be completely dry, since the specimen chamber is at high vacuum. Hard, dry materials such as wood, bone, feathers, dried insects, or shells can be examined with little further treatment, but living cells and tissues and whole, soft-bodied organisms usually require chemical fixation to preserve and stabilize their structure. Fixation is usually performed by incubation in a solution of a buffered chemical fixative, such as glutaraldehyde, sometimes in combination with formaldehyde and other fixatives, and optionally followed by postfixation with osmium tetroxide. The fixed tissue is then dehydrated. Because air-drying causes collapse and shrinkage, this is commonly achieved by replacement of water in the cells with organic solvents such as ethanol or acetone, and replacement of these solvents in turn with a transitional fluid such as liquid carbon dioxide by critical point drying. The carbon dioxide is finally removed while in a supercritical state, so that no gas-liquid interface is present within the sample during drying. The dry specimen is usually mounted on a specimen stub using an adhesive such as epoxy resin or electrically conductive double-sided adhesive tape, and sputter-coated with gold or gold/palladium alloy before examination in the microscope.

If the SEM is equipped with a cold stage for cryo microscopy, cryofixation may be used and low-temperature scanning electron microscopy performed on the cryogenically fixed specimens. Cryo-fixed specimens may be cryo-fractured under vacuum in a special apparatus to

reveal internal structure, sputter-coated, and transferred onto the SEM cryo-stage while still frozen. Low-temperature scanning electron microscopy is also applicable to the imaging of temperature-sensitive materials such as ice and fats.

Freeze-fracturing, freeze-etch or freeze-and-break is a preparation method particularly useful for examining lipid membranes and their incorporated proteins in "face on" view. The preparation method reveals the proteins embedded in the lipid bilayer.

Materials: Back scattered electron imaging, quantitative X-ray analysis, and X-ray mapping of specimens often requires that the surfaces be ground and polished to an ultra smooth surface. Specimens that undergo WDS or EDS analysis are often carbon coated. In general, metals are not coated prior to imaging in the SEM because they are conductive and provide their own pathway to ground.

Fractography is the study of fractured surfaces that can be done on a light microscope or commonly, on a SEM. The fractured surface is cut to a suitable size, cleaned of any organic residues, and mounted on a specimen holder for viewing in the SEM.

Integrated circuits may be cut with a focused ion beam (FIB) or other ion beam milling instrument for viewing in the SEM. The SEM in the first case may be incorporated into the FIB.

Metals, geological specimens, and integrated circuits all may also be chemically polished for viewing in the SEM.

Special high-resolution coating techniques are required for high-magnification imaging of inorganic thin films.

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СКАНЕРЛЕУШІ ЭЛЕКТРОНДЫ МИКРОСКОПТЫ
БИОЛОГИЯЛЫҚ СЫНАМАЛАРДЫҢ ҚҰРЫЛЫМЫН ЗЕРТТЕУДЕ ПАЙДАЛАНУ

Биологиялық сынамалардың, соның ішінде өсімдік жасушасының құрылымы мен құрылысын зерттеудегі сканерлеуші электронды микроскоптың маңыздылығы қаралған.

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ИСПОЛЬЗОВАНИЕ СКАНИРУЮЩЕЙ ЭЛЕКТРОННОЙ МИКРОСКОПИИ
В ИЗУЧЕНИИ СТРУКТУРЫ БИОЛОГИЧЕСКИХ ОБРАЗЦОВ

Рассматривается важность применения методов сканирующей электронной микроскопии для изучения биологических образцов, в том числе структуры и строения растительной клетки.

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СУҒАРМАЛЫ ЕГІСТІКТЕ СУ-ТҰЗ РЕЖИМДЕРІН ЖАҚСАРТУ

Андатпа. Мақалада Сырдария өзенінің төменгі ағысындағы суғармалы егістіктердің су-тұз режимдерінің жағдайы, Шиелі ауданы Бидайкөл суғармалы егістігіндегі тұз мөлшері мен жүргізілген жуып-шаю нормасының нәтижелері көрсетілген.

Кілт сөздер: Жуып-шаю нормасы, тұздану, қашыртқы, бақылау құдығы, тәжірибе алабы, су-тұз тепе-теңдігі.

Қызылорда облысына қарасты Шиелі ауданы бойынша 2013 жылы жалпы суғармалы жер көлемі 31118 га болды. Оның ішінде инженерлік жүйеге келтірілген суғармалы жер көлемі 25801 га, ал аудан бойынша жалпы егіс көлемі 22736 га құрады [1].

Шиелі ауданының ауа-райы жазда өте ыстық, қысы қатты суық келеді. Егіске қолайлы кезең сәуір айынан бастап қазан айының ортасына дейін созылады. Ең ыстық мезгіл шілде айы, ең салқын мезгіл қаңтар мен ақпан айлары саналады.

Аудан көлемінде кейбір жылдары гана болмаса жалпы жауын-шашын өте аз түседі. Ылғал қыс және көктем айларында түседі.

2013 жылғы Шиелі метеостанциясының мәліметі бойынша биылғы түскен ылғал мөлшері 164,7 мм болды. Ең жоғарғы температура $+27^0$С, ал ең төменгі $-4,8^0$С, орташа температура $13,3^0$С құрады [2,3].

Ауылшаруашылық дақылдарын суғаратын негізгі су көзі Шиелі ауданы бойынша Сырдария өзені болып табылады. Оның негізгі су алатын бөлігі Жаңа Шиелі магистральді каналы арқылы Төменарық деген жерден бастау алады. Бұл канал арқылы Ақмая,