

Scientific Writing

Your goal: Influence science/technology with your paper. You are aiming for a BROAD audience.

The challenge: you have a ~60sec to transmit your message.



Goal

- ⦿ Transmit your idea/results in the clearer way possible.
- ⦿ Enable the reader to easily understand the main ideas by simply skimming through the paper

References:

A Manual for Writers of Research Papers, Theses, and Dissertations:
Chicago Style for Students and Researchers

by Kate L. Turabian

<http://www.stanford.edu/~kcobb/writing/>

The Elements of Style by William Strunk J

Golden Rules

1. Cut! reduce unnecessary words and phrases

- ⦿ A sentence should contain no unnecessary words, a paragraph no unnecessary sentences.
- ⦿ Strategy: Think FIRST, aloud if possible what you want to say and THEN write it.

Example: A sentence from *IEEE Sensors*

“Studies on the bending losses for a variety of materials will provide the fundamental information for optimizing the bending radius and the ratio between straight sections versus bent sections for future miniaturized gas sensor design“

“The optimization of the radius and length of bent sections will enable future miniaturized gas sensor design.”

Examples:

“This letter is to state that this field of research should be regarded as non-fundable.”

“The field is non-fundable.”

“The expected prevalence of mental retardation, based on the assumption of a normal distribution of intelligence in the population, is stated to be theoretically about 2.5%.

“The expected prevalence of mental retardation, based on the assumption of a normal distribution of intelligence in the population, is stated to be theoretically about 2.5%.

“The expected prevalence of mental retardation, if intelligence is normally distributed, is 2.5%.”

Hunt down all unneeded words that might divert your reader from the main point you' are trying to make.

Very, really, quite, basically, generally

These words don't add much. Try the sentence without them.

Often “there are” is extra weight.

- ⦿ There are many researchers who are good teachers.
- ⦿ Many researchers are good teachers.

“ For practical applications as a portable sensing device, *it is* required that the waveguide is coiled.

“For practical applications as a portable sensing, ~~*it is*~~ required that the waveguide is coiled.

Unnecessary phrases

for the most part

for the purpose of

in the case of

in the final analysis

in the event that

it has been estimated that

it may be argued that

“In the case of measurements, the laser was rotated by 90 degrees clockwise...”

“In the measurements, the laser was rotated by 90 degrees clockwise...”

A direct comparison study between conventional and photonic bandgap waveguides has not been reported to date ***for the purpose of*** optimizing gas sensors based on these devices.

Clunky phrase

Equivalent

A majority of

A number of

Are of the same opinion

At the present moment

By means of

Less frequently occurring

Clunky phrase

Equivalent

A majority of

most

A number of

many

Are of the same opinion

agree

At the present moment

now

By means of

by

Less frequently occurring

rare

Wordy

in spite of the fact that

in the event that

period of four days

refer back

shorter/longer in length

had been previously found

Pointed

Wordy

in spite of the fact that

in the event that

period of four days

refer back

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had been previously found

Pointed

although

if

four days

refer

shorter/longer

had been found

Constantly be on the lookout for extraneous words that crop up like weeds....

Ask yourself, is this word or phrase necessary?

What happens if I take it out?

Most of the time, you'll find you don't need it!

Example:

“Brain injury incidence shows two peak periods in almost all reports: rates are the highest in young people and the elderly.”

Example:

“Brain injury incidence shows two peak periods in almost all reports: rates are the highest in young people and the elderly.”

“Brain injury incidence peaks in the young and the elderly.”

Golden Rules

1. Cut! reduce unnecessary words and phrases
2. Use active voice

Use Active Voice

Samples were fabricated

→ Which evokes the question, “Who fabricated the samples?”

e.g. “Mistakes were made.”

∴ Nobody is responsible.

vs. *The President* made mistakes...

Passive:

Major differences in response time of the two samples were found.

Active:

We found major differences in the response time of the two samples.

Sometimes it is appropriate to use the passive voice.

When the action of the sentence is more important than who did it (e.g., materials and methods)

The sample is etched using a secret recipe.

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3. Use parallel construction

Unparallel:

Aluminum is most quickly removed using a nitric and hydrochloric acid etching solution while sulfuric acid and hydrogen peroxide solution remove photoresist

Vs.

Parallel:

Aluminum is most quickly removed using a nitric and hydrochloric acid etching solution while photoresist is removed using a sulfuric acid and hydrogen peroxide solution.

Lists of ideas (and number lists of ideas)
should be written in parallel form.

Not Parallel:

If you want to be a good doctor, you must study hard, critically think about the medical literature, and you should be a good listener.

Parallel:

Not Parallel:

If you want to be a good doctor, you must study hard, critically think about the medical literature, and you should be a good listener.

Parallel:

If you want to be a good doctor you must study hard, listen well, and think critically about the medical literature.

Parallel:

If you want to be a good doctor, you must be a good student, a good listener, and a critical thinker about the medical literature. (noun, noun, noun)

Not Parallel:

This research follows four distinct phases:
(1) establishing measurement instruments
(2) pattern measurement (3) developing interventions and (4) the dissemination of successful interventions to other settings and institutions.

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Parallel:

This research follows four distinct phases:
(1) establishing measurement instruments
(2) measuring patterns (3) developing interventions and (4) disseminating successful interventions to other settings and institutions.

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4. Start the paragraphs with your main point *then* expand

- ⦿ Take 1 min to skim through the paper by Fan et al.
- ⦿ Can you understand what they did?

We designed and fabricated a ring resonator using CMOS compatible fabrication method. The method was developed in Cornell and tested in IBM. The structure was designed to exhibit a sharp resonance in the 1.5 micron wavelength spectral region.

We tested the structure using ultra fast pulses. We used a GHz scope and a detector with a time response of .5psec. The probe was tuned to a resonance of the ring at 1.5 micron.. The pump 1.5 fsec pump pulse was out of plane and probe was in-plane.

The structure demonstrated high switching performance over a wide spectral range. The measured modulation response was 90% modulation and the switching speed was 200GHz. The switch-on response is limited to the detector response. The modulation response for the probe tuned at the resonance was higher than the one tuned off-resonance.

Applications include telecom applications requiring small size components compatible with CMOS technology. Modulators and routers with GHz performance could be developed and integrated monolithically with electronics.

Abstract vs. Discussion

- What is the difference??

The introduction moves from general to specific.

The discussion moves from specific to general.

Introduction and Background

1. What's known
2. What's unknown
(limitations and gaps in previous studies)
3. Your burning question
4. Your approach/finding
5. Why your experimental approach is new and different and important

Polymer electrolyte membrane fuel cells can revolutionize the way we produce electricity, as they may be a very efficient means of converting chemical energy into electrical energy. Many of the current technology limitations are materials based. One example of a material deficiency is the corrosion of the catalyst support which limits its durability and operational lifetime.

Conducting carbon catalyst supports are currently used at both the anode and cathode but are only thermodynamically stable up to approximately 0.2 V vs SHE. Normal hydrogen/oxygen PEM fuel cell operation would ideally run at 1.2 V with transient operation up to 1.5 V vs SHE. These high voltages lead to support corrosion and significant device performance losses after relatively short operating lifetimes. More robust and corrosion resistant supports are needed.

Some metal oxides and metal nitrides offer tremendous opportunities as support materials due to their stability at high potentials and low pH, conditions like those in a fuel cell; however, many are electrically insulating. Synthesizing and studying the properties of doped and or partially reduced metal oxides and nitrides offers a wide array of possible new materials that meet many of the material properties requirements for operating in a fuel cell.

The Discussion

1. Key finding (answer to the question(s) asked in Intro.)
 - Supporting explanation, details (lines of evidence)
 - Possible mechanisms or pathways
 - Is this finding novel?
2. Context
 - Compare your results with other people's results
 - Compare your results with existing paradigms
 - Explain unexpected or surprising findings
3. Strengths and limitations
4. The “so what?”: implicate, speculate, recommend
 - Clinical implications of basic science findings

The Discussion

Things to avoid in the discussion:

- Do not simply repeat what is in the Results
- Do not try to explain every minor flaw
- Do not attempt to explain away every unexpected result
- Do not exaggerate or make extravagant claims
- Don't hedge

We show that high index-contrast can enable fundamental non-reciprocity. In contrast to previous works we show that the non-reciprocity is intrinsic and does not require the use of magnetic fields. While we have shown this phenomenon is dependent on input polarization and reflectivity of the TE and TM modes, it is solely the consequence of linear optical phenomena and is likely to occur in the nanoscale high-index waveguides that are used widely in industrial and academic research labs. Exploitation of this effect could alleviate the need to develop the variety of light-matter interactions aimed at producing nonreciprocity in an integrated format as well as enable new types of photonic devices capable of processing light based on its direction of propagation.

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Introduction vs. Discussion (general to specific, specific to general)